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DENVER SIP ELEMENT

REPORT ON STAFF RECOMMENDATIONS FOR SELECTION OF REASONABLY AVAILABLE TRANSPORTATION CONTROL MEASURES

PRESENTED TO
CLEAN AIR TASK FORCE AND
AIR QUALITY POLICY COMMITTEE

SEPTEMBER 6, 1978

I. INTRODUCTION

This report is the result of early presentations to and discussion by the Clean Air Task Force on the selection of reasonably available transportation control measures. These previous discussions have been centered on the identification, definition and effectiveness of general measures to reduce vehicle miles of travel (VMT) and air pollution emission. Packages of transportation control measures have been analyzed to determine the potential range of VMT reduction by 1982. A preliminary staff recommendation for reasonably available transportation controls has been presented and discussed by the Task Force. Based upon these discussions, this report refines that preliminary staff recommendation, further defines the measures, and attempts to make an initial assessment of their effectiveness in reducing air pollution emissions and other associated impacts. Due to the time constraints, a detailed description and identification of a means of implementation for every strategy has not been possible. Much of this work must be left to the continuing air quality program as established by the EPA/DOT Transportation-Air Quality Planning Guidelines. However, this is not to infer that actions should not and will not be taken as soon as possible (during 1979) on those measures which are presently available for implementation. In this report and the previous report to the Task Force on Transportation Control Measures, the staff has attempted to identify those measures which could be implemented within the next year.

II. TRANSPORTATION CONTROL MEASURES - STAFF RECOMMENDATIONS

The following tables and charts present in more detail the transportation control measures which the staff considers to be reasonably available or worthy of further evaluation prior to a final decision on the project or program.

RTD's transit projects which are in their transit development program are described first. These projects along with RTD's marketing and management efforts are the basis for achieving their goal of doubling ridership over the next 5 years. Two charts are included: One indicating projects slated for 1979; and another indicating projects through 1982.

Each RTD project has been incorporated in previous capital grant applications or will be addressed in upcoming capital grant applications for 1978-early 1979 submittals to UMTA. Projects are included that will be funded locally. All planning work has been undertaken or is in the final stages of refinement. Nearly all of these projects will be evaluated through the Unified Planning Work Program; for example, Park-n-Ride, Bike-n-Ride, Transportation Terminals, Free Fare, priority treatments, etc. Furthermore, there is an "Environmental Assessment" task in the UPWP to address the environmental impacts/ramifications of these projects. The individual charts also reflect implementation/staging schedules.

RTD PLANNED PROJECTS - 1979

PROJECT	DESCRIPTION
Transitway/Mall	Design/Construction
CBD Transit Centers	Relocation/Demolition
Transit Centers-- Park-n-Ride	Boyd's Crossing Boulder Sites 88th Avenue/I-25 Longmont Broomfield Bike Path Conifer Twin Forks El Rancho Parker Avoca Cold Spring Hallack Junction North Smoky Cutoff
Community Transit Centers	Boulder Northglenn Aurora Littleton Arvada Lakewood Englewood
Shelters, Signs, Bike Racks	Purchase and Install
VMSOSE:*	
Transit Information Displays	Purchase & Install
Garage Repair/Equipment Replacement	Purchase & Install
Communications	Purchase & Install
Revenue Process Equipment	Purchase & Install
Major Spare Components	Purchase & Install
Support Vehicles/Equipment	Purchase & Install
Safety/Training Equipment	Purchase & Install
Shop Tools/Equipment	Purchase
Transit Buses	Purchase 100
Vans	Purchase 8
Over-The-Road Coaches	Purchase 32

*Vehicle Management System Operations Support Equipment.

RTD PLANNED PROJECTS - 1979 (Cont'd)

PROJECT	DESCRIPTION
Maintenance/Storage Facilities:	
Boulder	Construction
East Metro	Construction
4th Metro	Acquire Land/Design
Longmont	Construction
Alameda	Design/Remodeling
Primary Corridors:	
Buchtel Corridor	Right-of-Way Acquisition/Design
On/Off-Street Improvements:	
Head-of-Line Priority Treatments	Construction
Interstate Highway Priority Treatments	Construction
Interstate Transfer Priority Treatments	Construction
RAUS	Construction
FAUS	Construction
Off-Street Improvements	Construction

RTD PLANNED PROJECTS - LONG RANGE

TIP-TSM	DESCRIPTION	1980	1981	1982
N-STREET IMPROVEMENTS	RTD Regional Aid Urban Systems (RAUS)	Projects to be selected annually from projects developed by cities/ counties.	Projects to be selected annually from projects developed by cities/ counties.	Projects to be selected annually from projects developed by cities/ counties.
AUS	Interstate Local Match			
AUS	Federal Aid Urban Systems (FAUS)			
RANSITWAY/MALL	CBD	Design/Construction		
RANSIT CENTERS	CBD	Design/Construction	Construction	Construction
ARK-N-RIDE FACILITIES:	Littleton			Construction
	Englewood			Design/Construction
OMMUNITY TRANSIT ENTERS:	Aurora	Design/Construction		
	Arvada	Design/Construction		
	Lakewood	Design/Construction		
	Merchant's Park			Design/Construction
	Colorado Boulevard/Evans			Design/Construction
F-STREET IMPROVEMENTS		Construction	Construction	Construction
ELTERS, SIGNS, RACKS	Shelters	Install	Install	Install
	Signs		Install	
	Racks	Install		

RTD PLANNED PROJECTS - LONG RANGE

TIP-TSM	DESCRIPTION	1980	1981	1982
VMSOSE:	Transit Information Displays	Install		Install
	Computerized Scheduling	Implement		
	Garage Repair/Equipment Replacement	Replacement	Replacement	Replacement
	Shop Tools/Replacement	Replacement	Replacement	Replacement
	Communications		Radios, Equipment	Radios
	Revenue Process Equipment		Fareboxes	Fareboxes; Processing Equipment
	Major Spare Components		Buy Ratio Per Bus	Buy Ratio Per Bus
	Support Vehicles & Equipment	As Required	As Required	As Required
	Safety/Training Equipment	Expand	Expand	Expand
TIP - LONG-RANGE FLEET MODERNIZATION/ EXPANSION:				
	Transit Buses		Buy 142	
	Intercity Buses			Buy 15
	Transitway/Mall Vehicles		Buy 15	Buy 15
	Vans	Buy 12	Buy 8	Buy 12

RTD PLANNED PROJECTS - LONG RANGE

TIP-TSM	DESCRIPTION	1980	1981	1982
MAINTENANCE/STORAGE FACILITIES:	Alameda	Design/Remodeling	Remodeling	
	Fourth Metro	Construction	Construction	Complete/Occupy
PRIMARY CORRIDOR PROJECTS:	East Corridor	(EIS)	Design/Construction	Construction
	Santa Fe Corridor	ROW Acquisition	ROW Acquisition	ROW Acquisition
	Buchtel Corridor	(Final Design)	Construction	Construction
	West Corridor			(Design)

The following charts give more detailed information about the remaining projects and programs considered by staff to be reasonably available or worthy of further evaluation for determining the project/program detail and the means of implementation by December 31, 1982. Due to recent discussion and a decision by the Clean Air Task Force to explore and support HOV lanes (treatments) where feasible for reducing air pollution, the category of freeway HOV lanes has been added to these tables for continued evaluation.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS

Project Description	Present Status	Necessary Evaluation	Implementation
Employer Transit Incentive Programs This strategy includes providing information on bus routes, monthly bus pass and token sales and subsidizing transit fares. Development of a program could be voluntary or required by the State through regulation. Any program should be supported by informational and technical assistance furnished by RTD and promoted by a coalition of representatives from business, RTD, DRCOG and the State.	RTD presently provides assistance to employers designed to encourage transit usage.	Voluntary efforts by employers to promote transit usage by their employees presently occurs. For a broader, more effective level of action, an employer transit incentive program may have to be required of larger employers. The attractiveness of transit incentive programs to employers is affected by considerations of parking supply, costs for additional parking, traffic congestion, etc. These and other potentially complementary aspects have not been fully evaluated. The various benefits of encouraging transit and other alternative modes of travel to work should be considered in developing and promoting this strategy.	Present through 1979.
Employer Carpool Incentive Programs This strategy includes employer and area based carpool matching information (supplied through DRCOG carpool locator service or other comparable methods) with the possibility of also providing	The State Air Pollution Control Division presently has a regulation (Reg. 9) which requires all employers of 50 or more employees to have a carpool matching program. The State is presently considering a revision to this regulation. DRCOG is preparing to improve the	It has been estimated that this type of incentive program may reduce the 1982 VMT by around one percent.	Present to early 1979.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
Employer Carpool Incentive Programs (Continued) preferential carpool parking for those employers/property owners who control parking spaces. Development of a program could be voluntary or required by the State through regulation. Program should be supported by an area-wide carpool locator service which is well marketed. The coalition mentioned under Employer Transit Incentive Programs could also help to promote employer carpool programs.	effectiveness and expand marketing efforts of its present areawide carpool matching service.		
Variable Work Hour Program This strategy is directed at encouraging better utilization of transit by extending the commuter period. Presently, bus service during the peak commuter periods (6 a.m. to 8 a.m. and 4 p.m. to 6 p.m.) is heavily utilized. Excess bus capacity exists during off-peak hours. A 4-day work week is a form of variable work hours which also extends the commuter period by lengthening the working day.	Variable work hour programs presently exist at both government and private offices. No inventory of systematic approach to promoting variable work hours presently exists in the Denver region.	DRCOG will soon be initiating a variable work hours study to be completed around May 1979. This study will include evaluation of effects of different programs on: 1. Vehicle Miles of Travel 2. Air Pollution Emissions 3. Transit Service 4. Carpool and Vanpool Usage 5. Traffic Volumes 6. Energy Utilization	The mechanism for implementation has not been adequately described nor established. The establishment of a coordinating group which may also promote other employer based strategies with specific objectives and commitments by this group may be appropriate. Unless specific commitments by government are included in implementing this strategy, credit from EPA may be difficult to obtain.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
Variable Work Hour Program (Continued) A coalition of business representatives and other governmental agencies as mentioned previously may be the appropriate mechanism to promote variable work hours by employers.		Institutional problems expected and suggested actions to overcome these problems will also be addressed.	
Reduce Parking Space/Employee Ratio in CBD Additional parking spaces are not constructed to keep up with employment increases in the CBD. Transit and ride sharing are recognized alternatives not requiring as much additional parking space.	The approximate parking space/employee ratio in the CBD was 0.48 in 1970 and 0.42 in 1978. This 8 year trend may not be reflective of the recent building boom in the CBD. Presently no parking authority exists and almost all parking lots are privately owned. Most of the CBD zoning does not require parking space (DURA area exception). However, there is no plan to limit the addition of parking spaces as they may be needed and profitable.	Evaluation of what is the future need for additional parking given continued development, increased transit usage, carpooling, vanpooling, etc. Also must consider economic impacts to business which may be both positive and negative. Parking management authority does not exist.	Presently occurring. Continuance of trend may be dependent upon establishment of a parking authority(s) and development of a planning and implementation program. (See parking management.)
TSM Projects High Occupancy Vehicles Treatments Interstate System $1,300,000 programmed for 1979 which should accomplish	An I-25 TSM Plan study is underway and scheduled for completion in September. The study shall	Remainder of the Interstate System needs further TSM studies to establish TSM priority lists.	Following establishment of priority list, it will be necessary to file EIS and design actual facilities.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
TSM Projects (Continued) as much as 25 ramp treatments. $5,250,000 programmed for 1980 and beyond.	establish a priority list.		
Primary System HOV with Ramp Metering on U.S. 6 $225,000 programmed for 1979 $1,000,000 for 1980 and beyond	Preliminary evaluation done.	EIS and further engineering.	
Van Pooling $126,000 for purchase of vans in 1979 combined with $859,000 from 1980 and beyond	Contractural difficulties in arranging the necessary operational agreements.	Yearly evaluation of performance to verify successes or difficulties and modification of the program on the basis of the evaluation.	
Carpool Matching $88,000 per year	Continuing program.	Continuing program.	Continuing program.
Signalization and Coordination Primary System funding about one signal this year for congestion relief.	No activities.	Signal warrants evaluation and engineering design.	
$630,000 programmed for 1980 and beyond.	No activity.	Signal warrants evaluation and engineering design.	

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
Urban System Funding Denver $300,000 per year for signal replacement of old equipment.	Continuing program.	Warrants evaluation and engineering design.	
Denver Suburban $700,000 per year for new signals and coordination of existing systems.	Project by project activities.	Warrants evaluation and engineering design.	
Bicycle Facilities Primary System $200,000 for f.y. 1979 $1,000,000 for 1980 and beyond (per priority list)	Study to establish priorities needs to begin.	Evaluate priorities.	Design.
Urban System $200,000 per year (approx.)	Project by project activities.	Warrants evaluation and engineering design.	
Long Range Element Activities On the Interstate System there are four projects aimed at relief of congestion at interchanges for a total of $1,300,000 in 1979 and $13,300,000 beyond 1980.	All environmental and preliminary engineering done.	None.	Final engineering or ROW purchases necessary.
On the Primary System there are two projects aimed at			

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
Long Range Element Activities (Continued)			
at congestion relief on Leetsdale and U.S. 285.			
Leetsdale - $1,000,000	Continuing project.	EIS and design.	Construct.
U.S. 285 - $3,200,000	New project.		Engineering, ROW and construction.
Santa Fe to Wadsworth			
Using Interstate Transfer Funds:			
CBD Mall - $18,000,000	Environmental assessment work has begun.	EIS	Follow-up UMTA funding necessary.
Arterial facility improvements			
on: Santa Fe - $28,000,000	EIS work underway.	EIS	Final design.
Kipling in Arvada - $ 6,000,000	EIS work underway.	EIS	Final design.
Alameda, Colorado to Havana - $ 4,000,000	EIS approved.	None.	
Hampden at I-25 - $ 800,000	EIS work to begin.	EIS	Final design.
Wadsworth, 6th to Hampden - $ 7,000,000	EIS work to begin.	EIS	Final design.
Urban System Spot Congestion Projects at Five Locations for 1978 and Beyond	Various	EIS	
Roadway Widenings			
Widening about 6 miles of roadway.	Various	EIS	

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
Vanpool Program 1978-79: DRCOG will conduct a pilot program to determine the feasibility of vanpooling in the Denver Metropolitan area. The pilot program will be conducted through projects with two private employers. In other words, persons vanpooling will be employed by the same company. Vanpooling will not be open to the general public, as is carpooling. By 1982: DRCOG will provide a service to employers, both private and public, to aid them in establishing and implementing vanpool projects for their employees. DRCOG's role will include management and marketing, not administration or operation.	Presently in Denver, the Conoco Company is implementing and expanding a vanpool project for employees. Rockwell International is in the process of establishing vanpooling in conjunction with RTD. Mountain Bell is also in the process of setting up vanpooling for their employees. Companies who have tried vanpooling unsuccessfully are Statirol, Johns-Manville and Frye Sills. The Colorado Department of Highways recently acquired two vans and are setting up employee vanpooling.	Since vanpooling is a relatively new concept in Denver, it is essential that it be tested before it is marketed on a broad participation basis. Once a pilot program is conducted and feasibility determined DRCOG will have acquired the necessary vanpool management knowledge needed to market the concept on a broader base. DRCOG will then be equipped to advise employers on how to set up and implement vanpool projects in the future.	1978-79: The following steps are involved in the implementation of the DRCOG vanpool pilot program. (A) Develop technical expertise in order to manage the pilot program. Technical information includes such areas as tax benefits for employers, insurance requirements, flex-time options, employee incentives, fare structure and cost retrieval analysis, etc. (B) Select two private employers to demonstrate vanpooling among their employees, (C) Establish vanpool projects with the two employers. (D) Implement vanpool projects with the two employers, providing information and assistance as an aid to their project operation and administration. (E) Monitor vanpool projects. Future: (A) Market and promote vanpooling on a broad base, utilizing mass media advertising, public relations, and

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
			person-to-person contact with employers; (B) Provide information and assistance in setting up vanpool projects with employers as part of their overall ridesharing program.
DRCOG Areawide Carpool Locator Service	DRCOG provides the "Carpool Locator Service" for the Denver region. It is a system whereby persons interested in carpooling can be matched by computer with other potential carpoolers having similar home and work locations. More importantly, the Locator Service offers a means by which employers can implement carpool programs for their employees.	In the three and one-half years that DRCOG's Carpool Locator Service has been in existence, many thousands of names have been processed and matched. The operation of the computer match system has become well established, and the need for the Locator Service has been demonstrated. However, the efforts of the Locator Service on the formation of carpools in Denver to date is undetermined (no study has been conducted since 1976). Efforts by DRCOG to promote and market the Locator Service have been minimal and not sufficient to produce maximum usage of the service. It is also evident that the internal operation (management and administration) is deficient in several areas.	9/78-4/79: Simplify survey (candidate data) form; refine process of updating candidate files; establish method of building candidate files; improve internal operations to cut back on match processing time; improve application of grid system to produce better matches, establish method of evaluating Locator Service. 1/79-6/79: Market and promote carpooling through: (1) mass media advertising; (2) public relations; and (3) person-to-person contact with employers and other groups.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
TIP Bicycle Projects			
I-25 at 119th Avenue (Bicycle/ Pedestrian Underpass)			78-79
SH 391 Kipling-Alameda to 6th (Bikeway)			78-79
SH 88 University to Santa Fe (Bikeway)			79-80
Little Dry Creek Clarkson to Hampden (Bikeway)			79-80
SH 391 Kipling 6th to 26th (Bikeway)			80-81
10th Avenue/Golden Road (Bikeway)			80-81
Restripping of S.H. to allow for wider right lanes.			79-80
Bicycle Plan Development of a Regional Bicycle Plan encompassing routes and bicycle facilities with possible inclusion of a regional bicycle community education program.	Materials and data gathering is underway. Analysis and evaluation is to begin in January.	Evaluation of routes, facilities, racks, rack locations and education programs.	Implementation is dependent on the content of the adopted plan.
Episode Restrictions in Auto Use This strategy could be a public awareness effort to reduce automobile travel on poor air pollution days by encouraging transit use, carpooling, and eliminating unnecessary trips. State regulated.	Efforts have been limited to public notification and voluntary action during extremely poor air pollution episodes.	Development of public awareness campaign strategy and/or other mandatory measures. Enforcement is difficult issue with any mandatory program.	Dependent upon program on regulation development, may be in 1979.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
CBD Principal Arterial HOV Lanes This would allow for locating HOV lanes on principal arterials leading to and from the CBD during the peak periods.	1) Exclusive bus lanes presently on Lincoln/Broadway during the AM and PM peak periods. 2) Bus lanes are planned for East Colfax corridor. The final location has yet to be determined.	Evaluate the feasibility of implementing exclusive HOV lanes during peak periods on Colorado Boulevard and West Colfax Corridor.	East Colfax Corridor by 1982.
HOV Lanes (Freeways) Project would include either exclusive HOV lanes on freeways or ramp metering coupled with HOV bypasses. (This project is also identified under TSM projects)	See TSM Projects, HOV Treatments, Interstate System.	Evaluate the feasibility of implementing HOV lanes on freeways with regard to several criteria, including air quality.	No implementation planned by 1982 See TSM projects, HOV Treatments Interstate System.
HOV Lanes on Santa Fe This strategy would provide at least one bus/carpool lane on Santa Fe Drive during the peak hours. This lane would operate between Bowles and I-25. Estimated Cost: $50 million. Minimal annual maintenance cost.	CDH has received approval from FHWA on the Santa Fe Six-Lane EIS. CDH could begin purchasing ROW within six months between Yale and Florida.	Another EIS is being prepared to discuss the impacts of the joint Development between CDH and RTD which provides for interchanges, grade separations, and an additional 50' of ROW for a transit facility.	If additional ROW for the joint Development could be obtained from the railroads, the HOV lane could be implemented by 1982. If the ROW is obtained from the businesses and motels, the project could be delayed until 1985.
Regional Traffic Control System This would allow synchronization of signals across jurisdictional boundaries. Estimated cost: $6 million capital costs, $1 million annual maintenance cost.	Most cities in the Denver Region have computer control of traffic signals, but the Denver area doesn't have a regionwide computer system to adjust the total system.	A preliminary engineering and feasibility study should be conducted to examine the benefits, costs, and implementation strategies.	This study could be part of the future Unified Planning Work Program.

PRELIMINARY STAFF RECOMMENDATION FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS (Continued)

Project Description	Present Status	Necessary Evaluation	Implementation
Parking Management This category includes types of strategies which create incentives for use of transit and ride sharing by managing the supply, cost and convenience of parking. Included in this general category are the following types of strategies: 1. Removal of on-street parking. 2. Use of fringe parking areas. 3. Preferential carpool/vanpool parking (pricing and/or location. 4. Off-street parking supply limitations. 5. Restrictions on morning parking. 6. Alteration of short term/long term parking rate structure. 7. Surcharge on all parking regionwide. 8. Combinations of the above. The actual description of this strategy for inclusion in the SIP has not been determined and will require further evaluation.	Parking is not managed in the region and very little planning is done to determine future needs, given assumptions about future transit patronage and ridesharing. No authority, either regionally or within the City & County of Denver, exists which can manage parking supply, rate structure, preferential carpool parking, etc., except on a very selected basis (e.g. publicly owned lots, employer lots, etc.). Fringe parking at Mile High Stadium is not well utilized (200 cars/day with a capacity for 5750 cars). RTD shuttle bus provides peak hour service from Stadium lots to and from CBD. No controls on parking in residential neighborhoods exist. Present off-street parking structure in Denver favors long-term parking.	The availability of alternative modes of travel that offer levels of service comparable to that offered by the auto is an important factor in determining the effectiveness of parking management strategies in reducing VMT. Given other modes of travel, transit and ridesharing, what is the most effective, least disruptive means to provide effective parking management? What is the mechanism for planning, implementation and enforcement of parking management in the Denver region? What mix and level of strategies is most effective and reasonable for Denver region? These and other questions need answers prior to any decision on appropriate SIP means.	Before 1983 (probably staged).

III. AIR QUALITY IMPACT OF REASONABLY AVAILABLE TRANSPORTATION CONTROLS - INITIAL ASSESSMENT

The attached Table A presents estimates of VMT and pollutant reductions resulting from the preliminary "reasonable and available" transportation controls as described in the August 16 memo to the Task Force. Consistent with the analysis of earlier packages, these impacts have been estimated using the Cambridge Systematics, Inc. sketch planning transportation model. It was not possible to simultaneously include all of the recommended actions in a single computer run. Several of the measures were estimated from independent runs of the same model and then combined with the package results in an additive fashion. While the results of the transportation control measures cannot be considered to be strictly additive, it is reasonable to add the effects of measures that would otherwise not be included in the package results; especially in light of the sketch planning character of the model and the large number of control measures being considered, many of which may be mutually supportive or contradictory. The results in the table are given for each of the measures that were assessed individually, for the other measures that were assessed together in a single computer run, and for the estimated combined effect of all the control measures that were recommended by staff as reasonable and available.

The modeling technique has been discussed at earlier presentations to the Task Force, but some of the model's features are worth noting again when this material is presented. The model considers the factors of travel time and cost, but cannot adequately represent the potential effects of marketing, aesthetic quality, and certain productivity improvements in transit service. Experience to date in the actual effectiveness of certain transportation controls indicates that the model results are within the appropriate range in estimating VMT reductions. The sketch planning model is the best tool currently available and is considered to be a "state-of-the-art" planning model.

Given the level of analysis implied by the model, the estimates of VMT and pollutant reductions should not unduly influence the final selection of reasonable available transportation controls. Previous assessments of "Current Policies" and "Maximum" packages have provided equal, if not more, instructive information by defining upper and lower bounds for VMT and automotive emission reductions through transportation control measures.

Due to limitations in the available modeling techniques, two of the measures that were included in the recommended "reasonable and available" list of transportation controls were not included in the computer runs. These are bicycle lanes and storage and episode restrictions on auto use. Parking management methods were not included in the package run because of the wide variety of methods that could ultimately be implemented. Table B summarizes the results for a range of parking management techniques that were developed in the Denver Region Parking Management Study.

TABLE A

1982.95

PRELIMINARY STAFF RECOMMENDATION
FOR REASONABLY AVAILABLE TRANSPORTATION CONTROLS:
EFFECT ON VMT AND AUTO EMISSIONS

Strategies	Percentage Change in VMT Relative to: Peak Hour VMT	Off Peak VMT	Total VMT	Percentage Change in Emissions Relative to: Peak Hour HC	CO	NO_x	Off Peak HC	CO	NO_x	Total HC	CO	NO_x
Strategies Estimated in Single Model Run[1]	-7.7	-0.4	-3.3	-10.7	-10.6	-5.3	-0.5	-0.5	-0.5	-5.0	-5.0	-2.3
Strategies Estimated in Separate Model Runs												
• Reduction in Park Space/Emp. in CBD	-3.4	-	-1.6	-3.0	-3.0	-3.6	-	-	-	-1.5	-1.4	-1.8
• Employer Base Subsidy of Transit Fares	-0.1	-	-0.1	-0.1	-0.1	-0.1	-	-	-	-0.1	-0.1	-0.1
• Flexible Work Hours	-0.3	-	-0.1	-0.4	-0.4	-0.3	-	-	-	-0.2	-0.2	-0.1
• Employer Information and Sales	-0.8	-	-0.4	-0.5	-0.7	-0.8	-	-	-	-0.2	-0.3	-0.3
• HOV Lanes on Principal Arterials to CBD	-0.2	-	-0.1	-1.6	-2.2	-0.4	-	-	-	-0.8	-1.0	-0.2
Estimated Combined Effect of Above Strategies (package + individual actions)	-12.5	-0.4	-5.4	-16.3	-17.0	-10.5	-0.5	-0.5	-0.5	-7.6	-8.0	-4.6

[1] Single computer model run included the following strategies:

- RTD Transit Development Program
- Employer Based Preferential Carpool Parking and Carpool Matching Program
- Santa Fe HOV Lanes
- Carpool Parking Price Incentives
- Employer Vanpool Programs
- Synchronized Regional Traffic Light System

TABLE B

EFFECT OF VARIOUS PARKING MANAGEMENT STRATEGIES ON VEHICLE MILES OF TRAVEL[1]

	Percent Change in VMT Relative to:			Percent Change in Emissions Relative to:								
	Peak Hr. VMT	Off Peak VMT	Total VMT	Peak Hr. Emissions			Off Peak Emissions			Total Emissions		
				HC	CO	NOx	HC	CO	NOx	HC	CO	NOx
Supply (Short Term)												
• 50% maximum single-occupant vehicles before 10 AM at DUM/City facilities	-0.4	-	-0.2	-0.4	-0.4	-0.4	-	-	-	-0.2	-0.2	-0.2
• 50% maximum single-occupant vehicles before 10 AM at Commercial facilities	-8.7	-	-3.7	-8.6	-8.6	-9.0	-	-	-	-4.0	-4.0	-4.0
• .5 maximum ratio single occupant space/employee at public institutions	-1.4	-	-0.6	-1.3	-1.3	-1.5	-	-	-	-0.6	-0.6	-0.7
• .5 maximum ratio single occupant space/employee at large employers	-4.1	-	-1.8	-3.8	-3.7	-4.5	-	-	-	-1.8	-1.8	-2.0
Supply (Long Term)												
• Restrict new parking construction	-6.8	-	-2.9	-6.0	-6.0	-7.3	-	-	-	-2.8	-2.8	-3.2
Pricing												
Parking Charge at Employer Provided Facilities												
• 50¢ at public institutions	-0.05	-	-0.02	-0.04	-0.04	-0.05	-	-	-	-0.02	-0.02	-0.02
• $3 at large employers	-0.8	-	-0.3	-0.8	-0.8	-0.9	-	-	-	-0.4	-0.4	-0.4
Price Increase for Long Term Parking at Commercial Facilities												
• 100% increase	-2.4	-	-1.0	-2.4	-2.4	-2.5	-	-	-	-1.1	-1.1	-1.1

[1] Parking Management in the Denver Region prepared for DRCOG by Cambridge Systematics, Inc.

IV. SOCIAL AND ECONOMIC IMPACTS - PRELIMINARY ASSESSMENT

The following materials present a preliminary assessment of the impacts, other than air quality, of the transportation control measures previously presented to and discussed by the Clean Air Task Force.

IMPROVED TRANSIT SERVICE

QUALITATIVE INFORMATION

ON AIR QUALITY AND SOCIO-ECONOMIC IMPACTS

OF 1979-83 TDP

PROJECT	SOCIO-ECONOMIC IMPACT
Transitway/Mall	Increase in CBD retail sales. Revitalization of downtown area. Generate additional sales tax revenues. Reduces need for further parking spaces. Accessible to elderly and handicapped COST: $13,000,000
CBD Transit Centers	Increased system productivity. Convenient transfers. Accessible to elderly and handicapped persons. Opportunity for joint development. COST: $17,000,000
Park-n-Rides Boyd's Crossing Boulder Sites 88th/I-25 Littleton Longmont Englewood Brromfield Bike Path 4th & Union Alameda & Havana Parker/I-225 Hallack Junction 120th/I-25 Paradise Hills Avoca Conifer Twin Forks Parker Lookout Mountain Evergreen El Rancho Genesee Park	Increased system productivity. Timed transfers. Improved system access. COST: $6,960,000
Transit Centers Boulder Northglenn Englewood Aurora Littleton Arvada Lakewood Merchants Park Colorado Boulevard & Evans	Better access to activity centers. Improved system access. "Pulse" operation for transfers. COST: $16,070,000

QUALITATIVE INFORMATION (CONT'D)

Shelters, Signs, Bike Racks	Constitutes passenger amenities. Encourages use of public transportation through a comfortable, convenient, easily understood system. COST: $2,660,000
VMSOSE	Constitutes the support elements necessary for system maintenance. COST: $7,760,000
Fleet Modernization/ Expansion Buses Transitway/Mall Vehicles Vans Total vehicles 390 Many used for replacement	Increase in system productivity. Increase in ridership. Improved accessibility for elderly/ handicapped persons. Overall increase in mobility. Convenient, comfortable, modern and safe transit fleet. COST: $48,600,000
Maintenance/Storage Facilities Alameda Garage East Metro Fourth Metro Boulder Garage Longmont Garage	Allows for the maintenance and storage of the existing fleet. Promotes fleet expansion and increased productivity/ridership at COST: $41,110,000
Primary Corridors	Increased mobility and system productivity. Upgrade existing facilities. Maintain long-range options for transit. COST: $55,600,000
On/Off-Street Improvements	Increased system productivity. Improve operational aspects of the bus system. Improve flow of traffic. Development of bus priority treatments. Increased ridership. COST: $3,400,000

The air quality impacts of the TDP are directly related to increased productivity of the bus system, the ambitious capital program outlined here and the resultant projected increase in patronage. Each project will have some impact on VMT reduction and reduction of traffic congestion. When measured these impacts are minimal. Current estimates are that the entire program will reduce VMT approximately 2.0%.

PARKING MANAGEMENT

Most of the following information has been extracted from the Cambridge Systematics study entitled, Parking Management in the Denver Region.

CASE STUDIES

This section very briefly summarized the efforts of nine U.S. cities to plan, implement and enforce parking management strategies. Parking management strategies have been implemented for a variety of reasons. Generating revenues, improving traffic flow on city streets, minimizing intrusion of commuters into residential areas and improving urban aesthetics are justifications, in addition to reducing air pollution. While many of the earlier parking management efforts were undertaken largely in response to EPA requirements, increasingly areas are tying parking management into an overall transportation system management effort. The following table summarized the strategies for selected cities which are intended to be representative of a range of activity and does not constitute a comprehensive national survey.

TABLE C

Representative Urban Area Parking Management Activities

City	Type of Measure	Status
San Francisco	Parking Tax	Implemented
Philadelphia	Change in Rate Structure to Favor Short Term Parking	Implemented
New York City	On-Street Parking Ban	Being Implemented Under Court Order
Chicago	On-Street Parking Ban	Implemented
San Diego	---------	Plan in Preparation
Los Angeles	Restrictions on New Construction with Provision for Parking Substitution Measures	Developed, In Review
Boston	Freeze on New Parking	Implemented
Cambridge	Resident Sticker On-Street Parking Permits	Implemented
Seattle	Freeze on New Parking	Implemented

SAN FRANCISCO - In October, 1970 a 25% tax on parking operations was implemented. In the face of considerable opposition, the tax was reduced to 10% effective July 1, 1972. An evaluation of the San Francisco experience was conducted by the Urban Institute, with the following key findings:

- Long term parking declined relative to short term parking, as commuters more than shoppers adopted travel patterns which avoided the parking tax;
- The number of vehicles parked was reduced by 2-6 percent with a 30 percent decline in total demand for parking services, a combination of the number of cars and the duration of occupancy;
- There was a substantial loss of revenues to parking operators (revenues were estimated at 36 percent below the level projected for normal growth and 31 percent below those experienced in the year prior to the imposition of the tax);
- Traffic on city streets was reduced by not more than two percent;
- There was a negligible impact on downtown retail activity.

The overall conclusion from the analysis is that decline in the demand for parking need not impact retail sales if they are offset by change of mode, increased purchases per trip, or concentration of shopping into visits of shorter duration.

PHILADELPHIA - A parking rate experiment has also been conducted here with preliminary analysis of historical data demonstrating that rate changes do affect the demand for parking, that increased turnover rates resulting from rates favoring short term parking increases facility utilization and that such changes are financially sound from the operators viewpoint.

NEW YORK CITY - This city is representative of those cities which have resisted implementation of parking controls included by EPA in the promulgated transportation control plan. However, Federal Court Action has affirmed the city's obligation to effectuate parking strategies. Eventually, a plan is to be developed that will reduce parking lots and garages in addition to extending the present on-street parking ban in midtown Manhattan.

CHICAGO - Many cities, in recent years, have attempted to reduce on-street parking, especially in heavily congested portions of the central business district. On-street parking restrictions on certain streets in the Loop, have been implemented here. According to one official, the ban has "...eased congestion and thus improved the flow of traffic through the Loop by an overall average speed increase of nearly 5 percent".

SAN DIEGO - San Diego, like Denver, has an excellent and extensive street

and freeway system with relatively low levels of congestion. Selection of parking strategies for San Diego, therefore, is being oriented toward providing incentives for the increased use of bus transit, park and ride and carpooling.

LOS ANGELES - The Southern California Association of Governments (SCAG) explored the idea of bringing the 125 member cities and six counties in the region under a single parking management plan, and eventually decided that it was infeasible because of the great diversity in local parking policies, as well as the fact that there was no regional transit to speak of that could be used to tie the area together. Instead, SCAG decided to develop regional parking management guidelines, which were to assist local jurisdictions in the development of individually tailored programs in a way that was compatible with regional parking management goals. Key points of the Los Angeles Plan relative to Denver include the following:

- The problems by SCAG in developing a regional parking management plan may be similar to those faced by DRCOG. SCAG's approach of developing regional guidelines offers one solution to this problem.

- Despite the fact that Los Angeles is highly automobile dependent, parking management strategies were developed in cooperation with business interests which have consciously built in a profit motive, and which point toward more efficient utilization of the transportation system and less automobile-generated pollution.

- Old parking policies have been recognized as a problem, both in perpetuating dependence on automobiles and increasing costs to developers.

BOSTON - Around 1972, a detailed study of the parking supply and use characteristics was undertaken and a core area was designated in which the supply of spaces was to be "frozen". Early implementation was slow and controversial. The freeze regulation was finalized in 1976 and a system was established whereby the maximum permissable number of spaces which are allowed in the freeze area is equal to the number in existance in October 1973. The freeze is administered by the City of Boston Air Pollution Control Commission and the Boston Redevelopment Authority provides staff assistance. Key points of the Boston experience relative to Denver include the following:

- Despite the fact that both city hall and the governor's office were receptive to the overall goal of reducing automobile use in the downtown, development of appropriate regulations was a time consuming process which required extensive negotiations among city agencies with various interests in parking.

- The attitude change on the part of the Traffic and Parking Commissioner emphasizes the need to involve all affected or interested agencies in the planning of parking management strategies.

- Enforcement of parking strategies, particularly those involving on-street

measures, may be critical to their successful operation. Constraints on enforcement should be considered at the time that strategies are planned.

- Now that the freeze regulation has been adopted, staff requirements for the strategy are small and consist primarily of preparation for the periodic hearings.

- Parking management strategies are being pursued despite the fact that Boston has a high transit modal share for trips downtown (greater than 50 percent) and some of the rail transit lines are at or near capacity during peak periods.

CAMBRIDGE - Cambridge is an immediately adjacent large suburb of Boston and is illustrative of the need for cities to develop cooperative parking management programs; particularly with respect to commuter parking. Cambridge initiated an experimental residential permit program prior to the development of EPA's transportation control plan. The motivation for the experiment was to discourage commuters who parked in the neighborhood and either walked over the nearby bridge to Boston or took the subway to downtown Boston. Under the current transportation control plan, Cambridge is continuing its residential permit program and is implementing a morning parking ban and a parking freeze. The morning parking ban has been controversial in Cambridge as the city has relatively little off-street parking, and some employees and businesses opposed the measure on grounds of hardship. To mitigate adverse impacts, the city has erected meters in front of businesses along commercial streets. Because the on-street ban offers significant benefits to the City in terms of facilitating street cleaning and snow removal, it has been given higher priority than the freeze.

SEATTLE - Seattle represents another major city that has recently taken initiative to limit the amount of new parking construction. This comprehensive program involves changes to the city zoning ordinances which will restrict the expansion of new-residential parking in the central business district and encourage the relocation of capacity to the remainder of downtown and the outlying areas. This program is being accompanied by incentives to multi-occupant vehicle use, including the establishment of several park and ride lots and low and free fare parking for carpoolers in the downtown area. Key points relative to Denver include:

- The comprehensive parking management program is being developed and implemented by the City of Seattle largely for air quality purposes, specifically to help mitigate the carbon monoxide problem in the central business district. Other jurisdictions in the region have not shown any inclination to develop parking management plans; in fact, the pro-growth attitudes of outlying jurisdictions strongly work against the development of a regionwide management plan.

- Development of parking restrictions in conjunction with incentives for

carpooling and park and ride, and expanded transit service such as a free fare zone during peak periods, provide a balance of incentives to ride sharing and disincentives to single occupant auto use.

FUEL CONSUMPTION

The decrease in fuel consumption associated with various parking management strategies is similar to that for VMT. There are exceptions to this general trend, however, which should be noted. Fuel consumption rate, in addition to being calculated as a function of average speed on a trip basis as with vehicle emissions, is also dependent on trip length as related to cold starts (i.e., longer trip lengths have a lower proportion of cold operation, and therefore are more fuel efficient) and increases in auto occupancy associated with carpooling and vanpooling (i.e., increased vehicle loads). (Fuel consumed in transit operations is assumed to remain unchanged.) For example, as a result of employer sponsored vanpool programs, work trip VMT is reduced by 3.8 percent. The corresponding decrease in fuel consumption of 2.6 percent is, however, over 1 percent less. This is because the vanpool program is comprised of work trips having a one-way trip length greater than ten miles. Since these longer-than-average trips typically are more fuel efficient (due to a smaller proportion of operation under cold conditions), the average percentage decrease in areawide fuel consumption is less than the average decrease in VMT.

An opposite effect is observed for CBD pricing measures where the percentage change in fuel consumption may be somewhat greater than the corresponding change in VMT. This can be attributed to the fact that increases in parking costs have a greater impact on workers from low income households and because workers from these households tend to have shorter than average trip lengths. Consequently, a larger proportion of shorter, less fuel efficient trips are affected.

TRAFFIC CONGESTION

Parking management measures, if not well designed, could concievably increase traffic congestion either by increasing the time spent searching for parking spaces or by concentrating parking facilities into a few locations creating the opportunity for additional peak period traffic conflict. Experience has shown, however, that it is possible to design parking measures so as to avoid these adverse impacts and, in many cases, even to reduce existing levels of traffic congestion. On a macro or regional scale, the decreases in work trip VMT translate directly into lower peak period traffic volumes as commuters shift to ride sharing and transit modes. Because of the widely dispersed nature of these volumes, though, such areawide reductions are not anticipated to be measurable on specific facilities. However, meaningful improvements in isolated locations of traffic congestion could be possible where parking management measures are implemented within specific employment or activity centers.

In assessing potential traffic congestion effects, it is necessary to examine the existing distribution of traffic volumes and travel times by facility type. As illustrated in Table D approximately 90 percent of existing

work and non-work travel now occurs under conditions that can be characterized as smoothly flowing. Freeway system congestion, generally concentrated at the interchanges along I-25, affects 1.5 percent of work travel, congested arterials affect 3 percent of work travel but are much less common than along the freeways. Traffic congestion within the CBD, though not separately tabulated, generally is not as severe as that which takes place on the freeway system. These figures indicate that congestion is primarily a localized problem, occurring either at specific intersections or along well defined corridors. They tend to confirm the hypothesis that parking measures are unlikely to have a regionwide effect on congestion, but potentially could help resolve localized problems.

Fuel consumption rate, as well as CO and HC emission rates, are correlated with travel time rate over a wide range of values commonly characterizing trip making in urban areas. Thus, decreasing traffic congestion leads to higher travel speeds and, in turn, to lower levels of fuel consumed and CO and HC pollutants emitted. A long standing concern, though, has been that such improvements in the quality of vehicular travel will be an inducement to increased quantities of vehicular travel and an associated increase in fuel consumption and pollutant emissions. Separate studies using Denver data have shown, however, that where areawide travel time is improved on the order of 10 percent, the energy savings attributable to this improved quality of flow is greater than the energy consumed by short range induced increases in travel. Net savings produced are approximately 3 percent for the Denver case analyzed.

TABLE D

Distribution of Areawide Traffic by Facility Type

Functional Class	WORK		NON-WORK	
	% of Travel	Avg Speed/mph	% of Travel	Avg speed/mph
Smooth Flow Freeways	20.5	46.2	22.	50.
Congested Freeways	1.5	12.5	0.	-
Smooth Flow Arterials	68.	21.2	68.	22.8
Congested Arterials	3.	14.6	3.	15.7
Local Streets	7.	20.	7.	20.

RETAIL SALES

Available evidence suggests that convenient parking makes an important contribution to the volume of sales and that lack of parking spaces with easy

access to stores would cause a significant decline in business. In addition, certain policies, either intentionally or unintentionally, may change the competitive position of one area relative to other areas within the metropolitan region. These potential secondary economic impacts are not unimportant. They can impose economic hardship, producing a loss of retail sales, a contraction of job opportunities, vacancies in buildings, and declines in the value of property as economic activity shifts from certain areas to other parts of the region.

Fear of such losses is particularly apparent in the central business district. Denver, like nearly all American cities, is seeking ways to stem decline of retail activity in the downtown in order to preserve its contribution to the municipal tax base and its employment opportunities.

Denver downtown retailers have conveyed a concern that if parking is removed to peripheral locations, the prospect of walking even a few blocks with packages or in inclement weather is seen as sufficient to create severe competitive disadvantage relative to suburban centers. Even shuttle buses providing frequent door-to-door service from peripheral lots to the retail center are regarded as a poor alternative to nearby parking for shoppers with packages to carry.

Parking measures to be considered should be designed either to avoid an adverse impact on retail sales or to improve the competitive advantage of shoppers in gaining access to existing CBD parking. For example, changing the rate structure of commercial parking to favor short term utilization increases non-work person trips to the CBD.

Two parking strategies which might be considered could result in potentially adverse effects on retail sales. Because of the existing capacity of parking available to non-workers, limiting the construction of new parking facilities is not expected to result in parking constraints by 1985 for most existing retail activity centers; sufficient excess capacity now is available to accommodate anticipated growth. This strategy, though, could limit the development of entirely new shopping centers. A regionwide parking surcharge would increase by $.25 the price of all non-work parking. This strategy would decrease shopping person trips regionwide.

A decrease in shopping person trips does not necessarily translate directly into an equivalent decline in shopping purchases, as purchases per trip may change as well as the frequency and destination of shopping trips. To further analyze these effects, a cross-sectional regression model has been developed with Denver data to estimate retail sales in different parts of the metropolitan area as a function of auto and transit access to households, household income, the number of nearby workers, and the accessibility to competitive shopping areas. In addition, the model accounts for "lag" considerations. New stores are not opened immediately, nor existing ones closed; households are governed by shopping habits acquired in the past; a reinforcing spiral of demand exists where second order changes in demand occur in response to subsequent changes in the size and attractiveness of a

retail center. Using this aggregate forecasting procedure, the addition of two and a half minutes to auto travel time to the CBD (for example, resulting from a decrease in available parking) produced a long-run sales depression of 17.5 percent (i.e., after all adjustments have taken place). This change in sales, however, occurs quite slowly, with only about 40 percent of the ultimate adjustment occurring in the first decade.

OFFICE EMPLOYMENT

Although retail business in the CBD is sensitive to the cost and convenience of access, the characteristics of downtown office activity are very different. The same inexpensive and convenient access provided to shoppers by suburban retail centers is provided to office workers by suburban office parks. Yet, while the downtown retail sector has fallen victim to suburban competition, the legal, financial, and energy activities of the region remain firmly anchored in the CBD. The need for mutual interaction has made the CBD much less vulnerable to suburban competition for these activities.

A successful downtown office complex is sustained by forces very different from those that govern the performance of retail sales. Whereas a retail center requires accessibility to customers, the occupants of offices in the CBD are there because they require a degree of accessibility to one another which is available nowhere else in the metropolitan area.

Employment in the office and retail core of the City of Denver grew at an annual average compounded rate of 4.3% between 1970 and 1977. Because all available evidence suggests decline in the retail sector, these gains can be attributed with confidence to growth in office work. In fact, to the extent that declines in retail employment have occurred, the change in total jobs understates the increase in office jobs.

Growth in downtown office space during this same period has been even more dramatic than growth in jobs, increasing 59% from 10,100,000 to 16,100,000 square feet. During the same period, both single office buildings and large office parks also were constructed in large numbers in the suburbs. The vacancy statistics in Table E substantiate the existence of two different markets for office space. As new buildings have been added, downtown space has been quickly occupied, while many suburban offices have been left without tenants. These large and persistant disparities in market behavior indicate that the two kinds of space are not good substitutes for one another. If they were, such differences would be unlikely.

This historical performance suggests that downtown office activity would be much less sensitive than retail sales to transportation measures that restrict auto access to the CBD. The need for interaction will outweigh any incremental impediments to access caused by a rise in costs or a limit to capacity for centrally located long-term (work trip) parking.

Interviews with members of the downtown financial community confirmed the implications of the statistical data. All stressed the need for accesibility

TABLE E

Vacancies for a Sample of Office Buildings in the CBD and in the Rest of the Denver Region

Date	CBD Number of Buildings	CBD Vacant Space (Sq. Ft.)	CBD Vacancy Rate	Rest of Region Number of Buildings	Rest of Region Vacant Space (Sq. Ft.)	Rest of Region Vacancy Rate
May 1, 1973	--	298,003	7.0%	--	423,116	17.8%
Oct. 1, 1973	--	551,037	11.5%	--	184,358	10.7%
May 1, 1974	--	361,810	7.5%	--	173,335	7.9%
Oct. 1, 1974	--	629,606	13.0%	--	597,554	21.9%
Oct. 1, 1975	36	413,265	9.0%	110	1,132,218	25.0%
May 1, 1976,	46	480,312	8.7%	109	1,876,039	32.8%
May 1, 1977	42	236,544	4.7%	89	1,007,135	26.5%

to other members of the CBD community as the dominant reason for choosing a site in the CBD. Other characteristics may be important to some office firms: The prestige of a downtown address; Public relations benefits that accrue from a decision not to abandon the city; Accessibility to clerical workers who must use public transit to travel to work. But, however important these attributes for the location decisions of particular firms, their contribution to the vitality of the office economy in the CBD is insignificant in comparison with the need for mutual interaction. Conversely, the amenities of the suburbs--the proximity to suburban homes, the convenient parking, the lower cost space, and green surroundings--are powerful only for firms where the need for interaction is weak.

IMPLEMENTATION ISSUES

Given an assessment of the effectiveness of a parking measure in changing travel behavior patterns, it is equally important to examine institutional, legal, enforcement, and other administrative issues that would be associated with implementation to determine a measure's actual potential. These considerations influence not only the overall effectiveness of a set of parking management actions but also the acceptability of the measures to the public and to the various institutions and interest groups involved in the implementation effort.

The existing distribution of authority over parking in the Denver area acts as a primary determinant of the kinds of measures which can be undertaken in the short run. As in other metropolitan areas, there is no overall regional control of parking and even within the City and County of Denver, responsibilities are assigned to several departments and offices. For example, despite the fact that the Planning Office's responsibilities include development of policies on transportation and parking, the policies are not binding, even on other city agencies. In practice, the Department of Public Works, the Urban Renewal Authority and the owners of commercial parking facilities have a great deal of latitude in determining where to locate parking facilities, how large to make the facilities and what rates to charge.

Additionally, although parking policies have long been a part of cities' traffic concerns, the regulation of parking to achieve goals such as protecting neighborhood integrity, improving urban aesthetics, and reducing automobile travel is a relatively new application, and one which has not met with universal approval. What is acceptable and workable in one area may be characterized as "un-American" or "un-Constitutional" in another.

EMPLOYER INCENTIVE PROGRAMS

Employers incentive programs include transit incentives, carpool matching and parking, vanpooling, bicycle incentives, and possibly staggered work hours, as described earlier. All of these programs are oriented toward the commuter, through employer action to induce transit usage, ridesharing, and bicycling as alternatives to single occupant vehicle use. These employer based programs can and will occur without the consideration of the air quality impacts and the State Implementation Plan. Some employers have found that providing employees with inducements for alternate ways of travel results in benefits to the employer such as reduced parking requirements and congestion relief. Vanpooling and staggered work hours are good examples of this. However, by considering these strategies for inclusion in the Denver air quality plan, the issue becomes one of if and how should these measures be institutionalized. In order to make such strategies a part of the State Implementation Plan, a program must be established to encourage and/or require these employer based programs. It is in the development of a program or regulation which requires employers to take action that hardship is usually claimed.

Adverse impacts to employers are usually claimed when the resources required to carry out the program are greater than the real or apparent benefits (e.g. paper work requirements). Beneficial effects occur when the employer incentives work in providing useful information, and a service to the employee which is well received and results in the formation of carpools, vanpools, etc. When the incentive programs work and reduce the dependance upon single occupancy vehicles; pollutant emmissions, energy consumption and traffic congestion is reduced.

Overall, the benefits of employer based carpool, transit and bicycle incentive programs outweigh any adverse effects to employers if the program requirements are result oriented, not just paper work, and flexible enough to be tailored to individual employer needs.

Signalization and Coordination and a Regional Traffic Control System

It is anticipated that these improvements will have positive social impacts because they increase accessibility to all areas of the region. This not only increases the convenience of the traveling motorist but also improves the economic viability of the region because it facilitates the movement of services and goods. Cost of the program could be high and should be considered in determining the extent of coverage for achieving the most effective system (requires study).

HOV Lane on Santa Fe

The implementation of a bus/carpool lane on Santa Fe Drive will result in the relocation of between 300 and 600 families depending upon which design alternative is selected. The economic viability of the corridor will be improved significantly because of the increased accessibility provided by transit and auto. Much of this growth and redevelopment can be accommodated within the activity centers which are designated in the corridor. An environmental impact statement is being prepared for the project.

HOV Treatments (Freeways and Arterials)

If properly implemented and operated, the economic and social benefits gained by implementing HOV preferential lanes can be measured in terms of increased accessibility and greater efficiency of the existing highway system. Care must be taken in design and implementation phase to minimize any disruptive effects, such as diversion of traffic to side streets. Proper location, design and public awareness efforts greatly enhance the success of HOV lanes and /or freeway metered ramps.

Variable Work Hour Programs

DRCOG is initiating a study of the potential effectiveness of variable work hour applications in reducing VMT, air pollution emissions, traffic volume, and increasing transit patronage, carpooling and vanpooling. This study will also address institutional problems and energy utilization. This study should form the basis for considering impacts in any efforts to further promote variable work hours.

Highway Projects - (TSM type projects)

As indicated earlier in this report, the more significant projects in terms of invironmental impact must undergo evaluation through the environmental impact statement process. Also, a screening process which considers a variety of criteria will be used in placing these projects in the TIP.

Regional Bicycle Lane and Storage

DRCOG will be conducting a study to determine the most effective bicycle ~~lane~~ system with emphasis placed on commuter and utility (shopping, etc.) trips. Regarding bicycle storage, implementation mechanism is an important consideration. This study will be the basis for future action and will consider all significant impacts.

IV. TRANSPORTATION CONTROLS NOT REASONABLY AVAILABLE BY DECEMBER 31, 1982

Fixed Line Rapid Transit

At the time that RTD prepared its grant application for the North-South Rapid Transit Project in 1975, it was estimated that if full funded the first useable segment would be completed in about five years. In June 1976 UMTA decided that in light of competing priorities throughout the country that Federal participation in a rapid transit investment for Denver would be premature. UMTA did support, however, transit investments that would proceed toward rapid transit at a more deliberate pace and preserve right-of-way opportunities for later development of rapid transit. RTD is continuing to work with CDH and DRCOG in identifying those investments that are most appropriate, e.g., Buchtel Boulevard and South Santa Fe.

Under present transit legislation there are no funds available that would permit RTD to begin work on rapid transit before 1982. Proposed legislation presently being considered by Congress might provide some additional funds for transit starts. At this time, expecting that, Denver could initiate and complete a major transit investment in Denver by end of 1982 would be very speculative.

Transit Free Fare

Over the past year, RTD has held extensive public meetings on its five-year program and the financing options available to accomplish that program. Generally, RTD has four major sources of revenues: Federal funding assistance for capital and operating programs; one-half of one percent sales tax levied throughout the District; farebox revenue and up to two and one-half mills of property tax to support the administrative and operating expenses of the District. These latter two revenue sources are considered the most discretionary in funding RTD programs. In the discussions that have been held over the past year it has been clear that the citizens of the District strongly believe that RTD should consider levying any property tax only as a last recourse in order to meet the financial requirements of the District. There has been strong sentiment expressed that farebox revenue should continue to support the major portion of operating expenses of the District. If RTD were to continue the free fare program in the off-peak only, then it is projected that the farebox revenue loss through 1982 would amount to $50.9 million. By the end of 1982 RTD would be levying its full statutory authorization of two mills of property tax to support the operating deficit, and at the same time would have to cut back its capital programs in order to generate additional revenues to support the operating budget. In summary, without additional revenue sources made available to the District, RTD could not support for an extended period the free fare off-peak program without compromising the ability of transit in the future.

Doubling Number of Park-n-Rides from Existing Plan

RTD's 1978-83 Transportation Development Plan includes 17 park-n-Rides; 4 others are completed and in use. The number of park-n-Rides in the 1978-83 program will cost approximately $7,000,000. RTD's total investment in park-n-Rides by 1983 would be approximately $12 million and will provide spaces for approximately 3,000 vehicles.

The RTD park-n-Ride program, which was developed in response to APCC's Regulation #9 has been a successful program to date. In the next UPWP, an extensive evaluation of the park-n-Rides will be undertaken to determine their effectiveness. After the grid system has been in place for several months, this evaluation will occur.

The capital investment involved in doubling the number of park-n-Rides would be approximately $84,000,000. Included in this amount would be 20 more park-n-Rides at $1.2 million; 160 new buses at $150,000 each and a new garage.

Road Pricing

In considering the addition of road tolls for all automobiles or for single occupant vehicles, only two basic areas of application were identified: Freeways and major arterials leading to downtown Denver. In order to institute tolls on Interstate highways (I-70, I-25, etc.), these highways would have to be bought by the State. It is also doubtful that tolls can be placed on any roadway which was funded by the Federal government without reimbursing them for these funds. Notwithstanding these difficulties, road tolls in the Denver area would probably cause a significant diversion of traffic to side streets until congestion increased and the decision to pay or wait in congestion was balanced. On arterials leading into the CBD, tolls would divert traffic to side streets on which tolls are not collected. This diversion of traffic would probably impact residential neighborhoods. It would be very expensive and disruptive to residences and businesses to place a toll booth on every street leading to the CBD.

B12

REVIEW OF SOME POTENTIAL TRANSPORTATION CONTROL MEASURES FOR THE DENVER REGION:

PARKING MANAGEMENT, AUTOMOBILE USE RESTRICTIONS, AUTOMOBILE RESTRICTED ZONES, BICYCLING, AND ROAD PRICING

September 6, 1978

Prepared by:

Planning and Analysis Section
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This report provides a review of five potential categories of transportation control measures which might be considered for possible application in the Denver Region. These potential measures - parking management, automobile use restrictions, automobile restricted zones, bicycling, and road pricing - are among those included in the list of potential "reasonably available" transportation control measures issued by the U.S. EPA in their guidelines for preparation of an approvable State Implementation Plan (SIP), and which must accordingly be addressed in the preparation of the revised SIP for Colorado.

This review was prepared by the staff of the Colorado Air Pollution Control Division, with assistance from the U.S. EPA and the Mountain Bicyclists Corporation.

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I. PARKING MANAGEMENT

A. INTRODUCTION

Parking management is the systematic control of automobile parking availability so as to influence the use of automobiles, and travel behaviors generally. Potential parking management strategies include a variety of measures using parking as both incentives and disincentives, depending on the type of travel behavior being encouraged or discouraged.

It is important to note from the start that parking management must be considered as part of an overall, encompassing "package" of transportation controls. Parking programs must be integrated with ridesharing strategies, transit ridership improvement, and the other programs designed to reduce automobile usage while providing acceptable alternatives for personal mobility.

The original (1973) Colorado State Implementation Plan (SIP) included a parking management plan. This plan was designed as a "contingency" level strategy for implementation if "primary" control strategies failed. The parking management plan was envisioned as being necessary only as an interim measure until primary strategies, such as those requiring new technology, could be implemented. However, the parking

provisions of the 1973 SIP were never implemented, since the EPA considered the "primary" control strategies sufficient to exclude Denver from requirements for a parking management program, as was proposed for 18 other cities. The EPA requirements for parking management programs were later abandoned altogether, following court suits and political action.

B. PARKING MANAGEMENT IN OTHER CITIES

Parking management programs have been implemented in several cities throughout the country. Information on success and failure of particular parking management strategies is difficult to obtain, due to the typical newness of these programs. A brief description of parking management programs established in several cities follows:

San Francisco instituted a 25% tax on all parking fees in October, 1970, primarily as a revenue generating measure. Opposition from retailers, parking facilities operators and commuters caused the tax to be reduced to 10% in July, 1973. The tax program caused a reduction in long-term parking as commuters resorted to alternative methods to get to work. Parking revenues were reported at 31% lower than before the tax. Negligible

impacts were observed on retail business. Traffic congestion was reduced by less than 2%. Parking demand dropped 30%, but there was actually only a 2-6% decline in vehicles parked; occupancy and parking duration changes caused this discrepancy.

Philadelphia began an experimental parking management program in October, 1970. Rates were altered at two publicly-owned parking facilities. Rates for long-term parking were increased at one garage, and held constant at the other with short-term fees reduced at both. Revenues and short-term parking increased at both facilities. Long-term parking decreased at the garage with the increased long-term rate, while it rose slightly at the other garage.

New York City was ordered by the U.S. District Court in 1977 to implement a parking management program for lower Manhattan. The program had originally been included in the Air Quality Maintenance Plan prepared by New York City, but the city had declined to implement it after its plan was approved by EPA.

Chicago has banned on-street parking in heavily congested areas. Traffic flows have been improved

and measured carbon monoxide levels have decreased.

San Diego began with an EPA-developed plan to review new parking facility plans and to establish a parking surcharge program. That plan was altered after considerable controversy, and now consists of only addressing parking supply issues in the area's comprehensive land-use/transportation plan.

Los Angeles tried to establish a regional program to bring the 125 cities and six counties in the metropolitan area under one parking management plan, but found the plan to be infeasible, due to the wide variety of local policies and the lack of an adequate regional transit system. Instead, a series of regional parking management guidelines are being developed to assist local governments in developing individually-tailored programs compatible with regional goals.

Boston instituted a parking supply "freeze" in late 1972. The process began with changes in the Boston zoning ordinance that had theretofore favored the construction of extensive parking facilities in the core city area. However, due to intense local political problems and resentment of the EPA, which

injected itself into the issue, the program was not finalized until 1976. Essentially, the program "freezes" the parking supply at the same level as October 1973. Spaces that are eliminated are put into a "freeze bank" and are allocated to new development.

Cambridge, Massachusetts, a suburb of Boston, found that commuters parked in Cambridge residential areas and went into Boston to their jobs by way of transit. A residential permit program was instituted in one neighborhood in 1972, which allowed only those cars registered to residents of Cambridge to park on the street. Non-resident cars were ticketed. The program has been considered a success and has been expanded into other neighborhoods. Cambridge has also instituted a 7-10 a.m. on-street parking ban. The ban not only discourages commuter parking, but also facilitates street cleaning and snow removal. One-hour parking meters were installed in front of businesses to permit limited-time parking for customers. It must be noted that Cambridge proceeded in its parking management program without time-consuming studies and the laborious preparation of extensive data

bases. Rather, it implemented its program gradually, modifying it when needed. Overall, the Cambridge program has been put into effect with a minimum of problems.

Arlington, Virginia has also instituted a residential permit parking program to prevent Washington, D.C.-bound commuters from pre-empting on-street parking in Arlington's residential areas. It is important to note that the Arlington program has been upheld by the U.S. Supreme Court and thus, provides a legal precedant for similar programs elsewhere.

Seattle developed a transportation control plan, intended to take effect in 1977, which included requirements that each parking facility make 10% of the spaces available for carpools, that parking facilities reduce total available spaces by 20% if the total area VMT is not reduced by 15%, and that a freeze on the amount of non-residential parking be instituted. However, the first two programs have been eliminated, and the current program is oriented toward zoning changes to encourage parking outside the CBD. In addition to the zoning provisions, the current plan calls

EPA program (and to its purported arbitrary manner of pursuing its objectives) caused the House Committee on Interstate and Foreign Commerce, in December 1973, to attach a rider to another bill which prohibited EPA from imposing parking surcharges without the consent of Congress. The bill and attached rider did not pass, but EPA interpreted this "guidance" from Congress as limiting its direct role in parking management, and in July, 1975, EPA suspended the parking management regulations. The 1977 Clean Air Act Amendments expressly limit federal review of parking only to federally-funded off-street parking facilities. These recent amendments leave most parking management programs up to state and local authorities.

D. LEGAL BASES FOR PARKING MANAGEMENT

Parking management programs have been established and enforced based on the general "police powers" of state and local governments to protect the public health, safety and welfare.

Parking management programs have often been subject to legal challenge. The most significant decision to date was rendered in October of 1977 by the U.S. Supreme Court. In County Board of Arlington County v. Richards, the Court

for parking incentives for high occupancy vehicles, park-and-ride transit facilities, and reduced parking rates for carpoolers.

Nottingham, England, restricts on-street parking and closes two major parking facilities between 7:30 and 9:30 a.m., to reduce peak period travel flows.

Marseilles, France banned parking in its downtown area for ten days and reported a 40% decrease in CO levels. Reduction in the number of vehicles traveling into the downtown area is believed to be the major source of this lowered CO level.

C. FEDERAL PARKING MANAGEMENT REQUIREMENTS

EPA promoted parking management strategies under the aegis of the Transportation Control Plans required by the Clean Air Act of 1970. Original proposals included federal review of all proposed parking structures of more than 50 vehicles and the changing of zoning laws related to parking space ratios. Later revisions raised the review level to 250 spaces, exempted church, residential and recreational parking, and replaced the review requirements with a five-year local government "plan" outlining parking management programs. Intense political opposition to the

held that a "municipal ordinance which bans commuter parking in residential neighborhoods in order to reduce air pollution and enhance quality of life is rationally related to legitimate legislative purpose." Numerous other cases have been tried in lower courts, and in most cases, the regulations have been materially upheld.

Governments can institute parking management programs through a variety of means. Parking policies at publically-owned parking facilities can be changed by right of proprietorship. The police power of governments permits restrictions on private parking facilities as well as on on-street parking if they are demonstrably in the interest of the public welfare. Taxes or surcharges may be imposed under the general taxation rights of government.

E. PARKING MANAGEMENT CONSIDERATIONS IN THE DENVER REGION

The most definitive work to date on parking management alternatives for the Denver Region is a study completed in early 1978, by the firms of Cambridge Systematics, Inc., and Leigh Associates, under contract to the Denver Regional Council of Governments. This study, entitled Parking Management in the Denver Region, was prepared in response to the requirement in Colorado Air Pollution Control Commission Regulation No. 9, that the DRCOG prepare a study of parking management alternatives for the Denver Region. While it is not the purpose

of this short paper to repeat that study, its "key findings" concerning parking management approaches deserve repeating in summary. The following narrative is accordingly summarized from the Cambridge Systematics/ Leigh Associates/DRCOG study:

1. The effectiveness of a particular parking management strategy in achieving reductions in areawide VMT is directly related to two factors: the severity of the strategy and the number of people affected by the strategy.
2. The availability of alternative modes of travel that offer levels of service comparable to that offered by auto is an important factor in determining the effectiveness of parking management strategies in reducing VMT. Where groups are well served by transit, strategies will be greatly more effective in reducing VMT compared to an equivalent situation where transit is not available as an alternative mode.
3. Choice of mode for work travel (and therefore work trip VMT) appears to be relatively insensitive to most of the strategies that are designed to discourage auto use by making parking more expensive and/or less conveniently located. On the other hand, those

strategies which regulate the number of spaces available, because they actually impose a constraint on the supply of parking, can be quite effective.

4. Measures can be combined into "packages" which are more effective in terms of reducing VMT than the sum of the individual measures. For example, if employer based carpool and vanpool programs are combined with measures restricting employer provided spaces to carpools, the resulting percentage change in VMT is significantly greater than the summed VMT reduction of the measures taken individually.

5. Those measures which can be characterized as being pricing disincentives are potentially inequitable in the distribution of their effects, resulting in greater percentage changes in VMT for lower and middle income households than for upper income households.

6. Parking management measures, if not well designed, could conceivably increase traffic congestion either by increasing the time spent searching for parking spaces or by concentrating parking facilities into a few locations creating the opportunity for additional peak period traffic conflict. Experience has shown, however, that it is possible to design parking measures so as to avoid these adverse impacts, and,

in many cases, even to reduce existing levels of traffic congestion.

7. Because of the existing capacity of parking in the Denver Region available to shoppers and other non-workers; limiting the construction of new parking facilities is not expected to result in parking constraints by 1985 for most existing retail activity centers; sufficient excess capacity now is available to accomodate anticipated growth. Such a strategy, though, could limit the development of entirely new shopping centers, and improve the competitiveness of CBD retail businesses.

II. PRIVATE MOTOR VEHICLE USE RESTRICTIONS

Perhaps the most direct means of reducing single-occupant automobile use and inducing a shift to other modes of travel, and thus reducing automotive emissions, is to simply restrict the right of automobile usage. While hardly popular, such programs have been successfully established in other countries for limited periods of time, due primarily to energy conservation needs.

The Netherlands and Belgium both established automobile use restrictions during the Arab oil embargo of late-1973/early-1974. In both cases, the restrictions involved bans on private automobile use on specific days of the week. The programs were apparently quite

successful in reducing automobile use, and thus fuel consumption, while also receiving seemingly good public support. It is important to note, however, that in neither case are the restrictions currently in effect; they were imposed during a period of clear national crisis, and were rescinded as soon as fuel supplies improved.

Whether resort to automobile use restrictions in the Denver area for purposes of reducing air pollution is feasible is highly questionable. However, it must be acknowledged that a well-designed program of auto-use restrictions would have undeniable air quality benefits. Accordingly, a hypothetical automobile-use restriction program for the Denver area is sketched out in this paper and briefly assessed.

A mandatory program of private auto-use restrictions in the Denver area would probably best consist of restrictions on automotive use one day out of the week. Many variations are possible, but for discussion purposes, it is suggested that a rotating schedule of restricted auto-use be considered. Under such a program, every private, non-commercial automobile (including company-owned executive cars driven to and from work) would be prohibited from driving on the public streets and highways one day out of each five-day (Monday-through-Friday) work week. Weekends and holidays would be exempt from such a restriction.

The schedule for a vehicles restriction would be determined by the last digit of its license plate number, similar to the way summer lawn watering has been restricted on a schedule determined by street

address numbers. Since the auto-use restrictions would apply on only the five days of the regular work week, and since there are only ten possible digits for the last digit of a license plate number, the rotation of restrictions would be determined by the following schedule:

Last Digit	Restricted Day
0 or 1	Monday
2 or 3	Tuesday
4 or 5	Wednesday
6 or 7	Thursday
8 or 9	Friday

The restrictions would not apply on weekends or holidays because traffic volumes tend to be lower on weekends and holidays, and because of the need to use automobiles for shopping, recreational travel, visiting, etc.

While it might be supposed that such a hypothetical auto-use restriction program could result in a 20% reduction in automobile use, it is likely that the actual reduction would be about half that, or about 10%. This is because most Denver area households typically are multi-car families; there are more two-car families than one-car households in the Denver Region, and more three-car households than no-car households. Thus, many trips would be made by private autos in spite of the restrictions, simply by using the household's other car(s). There would also be the inevitable

problems with cars registered in non-Denver area counties or out-of-state, even though their owners reside in the Denver area, making enforcement or restrictions on these vehicles difficult.

Nevertheless, a conservative estimate of a 10% reduction in automobile use is extremely significant from an emissions reduction standpoint. Assuming that such a program of auto-use restrictions is imposed, a 10% reduction in automotive use, translated as an assumed 10% reduction in vehicle miles traveled (VMT) and an assumed concomitant 10% reduction in automotive emissions, could by 1982 be expected to result in about a 20% reduction in the gap between projected CO emissions levels and the emission level needed to attain the CO standard. For ozone, such a 10% auto-use reduction could result in a 20-25% reduction in the gap between 1982 emission levels and the current 0.08 ozone standard; for the proposed 0.10 standard, the shortfall could be reduced by 40-45%.

In considering a program of private automobile-use restrictions, such as that discussed here, a number of advantages and problems are apparent. Among the advantages are:

- provides a direct and dramatically-effective means of reducing automotive emissions.
- burden of restrictions is placed randomly and equitably on virtually every automobile owner.

- by providing a regular schedule of restrictions (i.e., same day every week), arranging alternative means of travel (carpooling, transit, etc.) is facilitated.
- has numerous collateral benefits, including energy conservation, traffic flow improvements, etc.
- provides "average citizen" with a direct, active responsibility in reducing air pollution.
- enforcement is relatively simple, since a car's license plate will visibly indicate its scheduled "no-drive" day.

There are, of course, many disadvantages and problems to a program of automobile-use restrictions. These include:

- problem of public and political acceptability. Will Denver area residents accept direct mandatory restrictions on their use of the automobile to improve air quality? Will the region's political leadership back such a program and recommend it to the public?
- may place serious burdens on those for whom there is no practicable alternative to use of the automobile, especially in one-car households.

- problem of real or perceived inequities, such as between area residents with cars registered in the region's counties and those with cars registered elsewhere in the state, or out-of-state; between area residents with auto-use restrictions and unrestricted through traffic (tourists, out-of-town travelers, etc.)
- to be successful, restrictions must be enforced, which may place significant burdens on area police departments.
- problem of "special cases," such as the person who must drive on Tuesday when his "no-drive" day by chance falls on Tuesday, or emergency or quasi-emergency situations requiring use of the automobile on restricted days, etc.

The program of private auto-use restrictions discussed here is hypothetical, and is presented by way of example of how such a program might be established and what its effects might be. Many other variants on the restriction of private automobile use are possible, including:

- auto use restrictions applied only to single occupant automobiles, where vehicles with the driver as sole occupant would be restricted on certain days of the week; or

- auto use restrictions applied only during certain time periods of each day, where a vehicle would, for example, be prohibited from traveling during the morning and evening peak three-hour traffic periods on a specific day of the week, determined by license plate digit.

Overall, restrictions on use of private automobiles, whether by a program such as that hypothetically suggested here, or in some other form, potentially offer significant air quality benefits. However, whether these benfits are sufficient to convince the public and the political leadership and whether they offset the undeniable problems, is problematical.

III. AUTOMOBILE RESTRICTED ZONES

Automobile Restricted Zones (ARZ's) are areas where private and commercial motor vehicle traffic is restricted or prohibited. Most typically, ARZ's take the form of malls where pedestrians, and sometimes transit, receive priority or exclusive use of an area. However, other types of ARZ's are also extant.

Whether ARZ's offer significant potential reductions in automotive emissions is debateable; rather than a general answer being available, this can only be determined on a case-by-case basis. To date, most ARZ's in the United States have been established as malls in central business districts to help make them more

attractive and improve their competitiveness with suburban shopping centers. Since these malls have been implemented primarily for economic reasons, little study has been made of their effects on air quality. Typically, malls considered "successful" in the United States have been those that resulted in increased sales, improved tax bases, etc., with little or no consideration of air quality, except perhaps after the fact.

Malls and other ARZ's have been developed in North American since 1959, when the first pedestrian mall was opened in Kalamazoo, Michigan. Presently, over 80 cities in the United States and Canada have developed or are planning various types of malls or other ARZ's. Besides pedestrian malls (which includes Boulder's Pearl Street Mall), there are fifteen "transitways" (including Denver's proposed 16th Street Mall/Transitway) which give some sort of priority or exclusive access to transit along with pedestrians, and two enclosed malls (built over streets). In length, they run from one block to fourteen blocks, with transitways usually being longest. The longest pedestrian mall is ten blocks, in Memphis, Tennessee.

In Europe, ARZ's have been developed since the post-World War II reconstruction. Attention in Europe has tended to be directed more toward larger-scale ARZ's, rather than linear malls, largely in an effort to restore to the older core areas of the cities some of the old ambience that was disrupted by the ubiquitous automobile.

Again, however, little attention has been given to air quality, except perhaps as an afterthought.

European ARZ's present a broader array of options than have been used so far in North America. Perhaps most dramatic has been the total bans placed on motor vehicles in many old, historic piazzas in Rome, Verona, and other Italian cities. More significant, perhaps, have been the development of the traffic cell concept (Gothenburg, Sweden) and similar "zone and collar" concept (Nottingham, England). The concept of traffic cells involves dividing an area up into a number of zones or cells, encircled by a ring road. Traffic is not necessarily restricted within each cell, but traffic movement directly between cells is prohibited, except for transit. Instead, travel between cells must be via the ring road, access to which is provided at only a limited number of points from each cell.

Establishment of a traffic cell system in the old central core area of Gothenburg, a city of 440,000, resulted in major decreases in automotive traffic. In 1970, a 1/4-by-1/2 mile area of the city's core was divided into five zones, with only transit vehicles being permitted to travel directly between zones; all other traffic has to use a circumferential ring road to move from zone to zone. This program resulted in a decrease in traffic within the cells of from 5-70%, while traffic increased on the ring road and peripheral streets by 1-45%. It was found

that these shifts in traffic reduced carbon monoxide levels in the old core area from 30 ppm to 5 ppm or less. No information is availabe on the effects on regional air quality, but they are likely to be slight.

Nottingham's "zone and collar" approach provides a negative example of how a conceptually-good idea failed through flawed execution. The zone and collar concept is the reverse of the Gothenburg "traffic cell" approach, in that, rather than divide the city core into cells connected by a ring road, the residential districts were divided into zones, access from which to the CBD was limited by a "collar," through which there was restricted traffic capacity from each zone. The concept, implemented in 1975, was to impose time delays for the private auto by creating congested situations at both the exit from each residential zone and the entrance into the CBD. Preferential passage was provided for public transit.

The ring and collar approach was abandoned after 11 months, due to severe problems. Excessive clogging at collar entrances resulted in blockage of bus lanes, thus, negating the time advantages supposedly given to transit.Through traffic, not having adequate by-passes, added to the congestion. A second problem was that motorists came to disregard the restraints (a system of timed lights) and major problems with public acceptance developed. It is likely these problems could have been avoided had the "collar"

been located further out, with adequate bypass routes and sufficient lane queing capacity to keep bus lanes from being blocked. In addition, fewer, higher capacity zone exits pro

should have been provided. Finally, failure to gain public acceptance was shown to be crucial.

Another type of restricted zonal access approach involves limiting roadway traffic capacity in a specific zone. An example is the five-block mall in downtown Grand Junction, Colorado. Instead of establishing a typical auto-free mall, it was decided to permit traffic through the area, but at greatly reduced flows. Accordingly, the roadway was laid out in a sinusoidal or wavy pattern, with a single lane in each direction. Traffic signals, speed limits, and numerous pedestrian crosswalks all severely restrict traffic capacity and favor the pedestrian. The result is a very limited flow of traffic through the downtown area.

Regardless of the type of ARZ which may be considered, very little information is available on its impacts on air quality. Except for the Gothenburg, Sweden data, referred to earlier (a reduction in CO from 30 ppm to no more than 5 ppm in the core area), and findings in Cologne, West Germany, which showed reductions in CO from 8 ppm to 1 ppm in two areas where pedestrian zones were implemented, little in the way of "before and after" studies have been made.

Most analyses of the air quality effects of ARZ's have been hypothetical, rather than empirical, being based heavily on assumptions and, often, desires. In looking at the mall-type ARZ which is most typical in the United States, it is probably fair to say that if well designed and executed, a mall may reduce localized "hot spot" pollutant concentrations somewhat. In the case of the proposed 16th Street Transitway/Mall in Denver, for example, total pollutant concentrations in the CBD are not likely to be directly affected by development of the mall in the short term (through 1982), since downtown area traffic volumes are projected to remain essentially unchanged. It is possible that air quality standards may be achieved on 16th Street, itself, through elimination of the congested traffic flows along that street and thus, the reduction in street-level pollutant concentrations, particularly of carbon monoxide. However, it is just as likely that pollutant concentrations may be increased on adjacent streets carrying the traffic no longer permitted on 16th Street, and there is also some question about the effects of emissions at the intersection across 16th Street.

If malls, such as Denver's 16th Street, are to have any significant air quality benefit, it will likely be through overall increases in transit patronage and a concomitant decrease in automobile travel, due to improvements in transit operating

efficiency and productivity. For example, the Nicollet Mall/ Transitway in Minneapolis, Minnesota, opened in 1967, has been relatively successful, bringing in over 50% of its workers and visitors by transit. In Nottingham, England, a Central Area project which eliminated through traffic and reduced circulating traffic by 50%, with priority given to pedestrians and transit, greatly improved bus service reliability and resulted in significantly increased patronage. Similar expectations are held for Denver's 16th Street Transitway/Mall, which it is hoped will greatly improve transit speed and reliability through downtown Denver, thus, directly attracting more riders and also, more importantly, increasing the number of runs per unit of time a bus can make, thus, increasing productivity and improving levels of service. If significant gains in transit productivity and efficiency can be realized, there potentially may be a region-wide air quality benefit as additional travelers switch from autos to transit, given its increased reliability, service, and capacity.

Downtown Denver, while the most obvious location for an ARZ, is not necessarily the only area in which an ARZ might prove beneficial from an air quality perspective. There are perhaps 15 to 30 areas in the Denver Region that are major concentrations of activities in which potential localized and regional air quality benefits might be realized through establishment of ARZ's. These areas, most of which are rapidly

developing and are primarily oriented toward the automobile, are the nodes around which most of the region's activity revolves. As an alternative to increasing the amounts of parking in those areas and upgrading roadway capacity to them, transit, bicycle, and pedestrian access and circulation could perhaps instead be given precedence.

If economic considerations are the only primary factors influencing the planning and development of major activity centers, the effects on air quality will probably be negative. An area which is economically successful is one that attracts large numbers of people, whether for work, shopping, or other pursuits. If provision is not made for these people to travel to these major centers by means other than the automobile, and if automobile access is not made less paramount and convenient, little can be expected in the way of reducing dependency on the automobile for travel. Continued high quality economic development does not necessarily depend upon unfettered automobile accessibility, nor is it necessarily incompatible with sensitively-designed, well-executed ARZ's. Indeed, a well-designed ARZ integrated into an activity center's overall development scheme may enhance the attractiveness and viability of the activity center.

As the Denver Region's activity centers develop and grow, the same priority should be given to improving air quality as is given to considerations of economic advantage and viability.

Not only should improvements to localized air quality in the vicinity of such developments be of concern, but also contributions to improving regionwide air quality by reductions in total single-occupancy vehicle trips should be sought.

If successful ARZ's are to be developed in the Denver area, it is crucial that public transit service to the ARZ be improved so as to minimize congestion and obstructions to both through traffic and traffic to the ARZ area; through traffic bypass routes are especially important. Good pedestrian, transit and bicycle access to and circulation within the ARZ must also be provided.

THE DENVER POST

Tuesday, September 5, 1978

Boston Bans Private Cars In 10-Block Retail District

BOSTON (AP)—Private cars were banned from the heart of Boston's retail and business district Tuesday as the city launched a federally financed $3.2 million project to attract more shoppers and eliminate traffic congestion.

Truck deliveries were allowed only before 11 a.m. and taxis only after 7 p.m. in some parts of the 10-block restricted area.

The new de-motorized zone gives pedestrians exclusive use of parts of Washington Street, where major department stores are located.

The taxi and truck restrictions will be enforced in the central part of the area. Emergency vehicles will be allowed at all times.

The city's Traffic and Parking Department promised "100 percent" enforcement of the auto ban, with a concentration of tow trucks and personnel in the area.

"It should be mass confusion until everybody gets used to it," said Patrolman Raymond Jackman.

The plan calls for covering much of the area with brick, building islands for buses and improving street lighting. It is expected the project will take a year to complete.

ROCKY MOUNTAIN NEWS

Wednesday, September 6, 1978

Downtown Boston now haven for pedestrians

BOSTON (AP) — Pedestrians spilled into the streets of the downtown shopping district Tuesday and casually strolled down the pavement, no longer terrified of Boston's menacing drivers.

Tuesday was the first day of a federally funded program banning cars from the core shopping district in an effort to attract consumers back from the suburban shopping malls.

"It's much more pleasant," said Larry Kirkman, 49, a free-lance writer from New York. A native of Boston but a New Yorker the past 25 years, Kirkman returns here about every six weeks.

"I wish we had this in New York. The little triangular parks and the awnings over the sidewalks are fantastic. I like the old city of Boston and this is the way it should be."

The district is off-limits to all cars. Delivery trucks are allowed before 11 a.m. and after 7 p.m. Cabs are allowed at certain times of the day and buses from the suburbs will be allowed to enter Sept. 9.

"It makes traffic terrible but I guess it's good for the shoppers," said Paul Geary, 30, who had just finished his part-time shift as a shoe salesman at Jordan Marsh in the heart of the walking district. "Traffic this morning could have been rerouted better."

IV. BICYCLING

As an alternative, non-polluting mode of personal travel, bicycling offers tremendous potential as a means of reducing automotive travel. Unfortunately, bicycling is a travel mode for which the potential, great though it is, has so far been realized in only the most minimal way.

A. POTENTIAL FOR BICYCLING AS A TRAVEL MODE

As a means of transportation, rather than recreation, bicycling is considered to be most applicable to trips of five-to-seven miles or less in length. It is generally fair to say that a bicycle provides a feasible means of travel for most trips of five and one-half miles or less. Since an "average" adult in good health can reasonably maintain a steady speed of at least fifteen miles per hour on a bicycle, this means that a bicycle trip of five miles or so should take only twenty minutes or so. It is also generally considered that bicycle travel times cannot exceed thirty minutes, as a practical matter.

The average automobile trip distance in the Denver Metropolitan Area in 1975, for all auto trip purposes, was only 5.9 miles, and took an average of just over fifteen minutes to complete. These figures compare very favorably with the optimal bicycle travel range of 5.5 miles or less, and the ability of a bicyclist to cover such a distance in about twenty minutes. It is, thus,

appropriate to say that nearly half of all automobile trips in the Denver Area are realistically amenable to being made by bicycle, in terms of distance and travel times.

The topography and climate of the Denver Region are almost ideally suited to travel by bicycle. The generally flat-to-rolling terrain characterizing the metropolitan area presents few obstacles to bicycle travel. The climate is celebrated for its relative mildness, and is conducive to bicycle travel more than 300 days per year. Overall, there exist no significant natural obstacles to widespread use of the bicycle as a travel mode in the Denver Region.

B. BICYCLING AND AIR QUALITY

Based upon national statistics, it is estimated that about 13% of the vehicle miles traveled (VMT) in the Denver Area is accounted for by trips of five and one-half miles or less, and that these trips constitute about 48% of all trips made in the Denver Area. If it is conservatively assumed that actually about 40% of the auto trips are potential bicycle trips (PBT), and assuming that the 13%/48% ratio of VMT-to-PBT is reasonable, then the VMT associated with an assumed PBT of 40% is about 11%. This means that about 40% of the auto trips in the Denver Area may be considered as potential bike trips, with a potential for an 11% reduction in auto VMT.

It is estimated that total VMT in the Denver Region in 1977 was about 19.3 million miles traveled per day. Assuming that PBT auto trips accounted for 11% of this VMT, about 2.12 million miles of travel per day could potentially have been made by bicycling. On an annual basis, this amounts to well over 600 million miles of auto travel which can be considered to be potential bicycle travel.

If, with implementation of proper supportive policies and programs, only 10% of the so-called potential bicycle trips could be translated into actual bicycle trips, automotive VMT in the Denver Region could be reduced by over 210,000 miles per day, or over 60 million miles per year. The reduction in VMT due to actualization of only 10% of the PBT auto trips would be expected to result in reductions in carbon monoxide emissions of over 8,000 tons per year, to reduce hydrocarbon emissions by over 700 tons per year, and to reduce particulate emissions by about 40 tons per year. If it is more optimistically assumed that only 50% of the PBT auto trips can be transferred to actual bicycle trips, CO emissions could be reduced by 40,000 tons per year, HC emissions could be reduced by 3,500 tons per year, and particulate emissions by 200 tons per year.

As this exercise shows, the air quality benefits to be realized by large-scale use of the bicycle as a travel

mode are potentially very significant. Unfortunately, it is estimated that at this time less than 1/10th of 1% of potential bicycle trips are actually being made by bicycle. The problem, then, is to establish the policies and programs which will support and facilitate bicycle use, while removing or minimizing the many obstacles now impeding widespread bicycle travel. The Denver metropolitan community needs the civic acceptance of and commitment to the bicycle as a viable transport mode.

C. BICYCLING FACILITIES NEEDS

The most successful bicycle-use facilitating programs have been supported by statute or ordinances. For example, the lack of secure, adequate bicycle parking facilities has long been recognized as one of the greatest deterrents to bicycle use. To overcome this problem, Albuquerque, New Mexico has established provisions for bicycle parking facilities in its zoning code, which specify minimum criteria for adequate bicycle parking at all public facilities, public accomodations (stores, restaurants, etc.), and multi-family housing. The bicycle provisions in the Albuquerque zoning code are regarded as a landmark support for bicycling, and are expected to significantly enhance the attractiveness of bicycling as a travel mode. It also appears that businessmen are finding that by encouraging bicycling, automobile parking requirements can be reduced.

One of the greatest bicycling needs in the Denver Area is for the widespread provision of properly located, secure bicycle parking facilities. At present, for example, there are only about 150 bicycle parking spaces in the entire CBD, many of which are inadequate in design or location. The situation is no better elsewhere in the region, with the exception of Boulder, which has been more supportive of bicycling. For bicycling to realize its potential, parking facilities must be provided in all public and private business centers, recreational centers, and other major activity points.

Besides provision of bicycle parking facilities, the most pressing need is for the establishment and construction of bike paths and lanes, the provision of "curb cuts" where bike paths cross roadways, and intersection improvements to improve bicycling/traffic safety. To provide these crucial facilities, local ordinances and zoning codes should require that new arterial roadways and widenings of existing arterials include sufficient rights-of-way for bicycle lanes or paths, and that such facilities be provided, along with curb cuts, intersection safety features, appropriate signing, etc.

An evaluation of the existing bikeway system should be conducted both regionally and within each municipality. Many existing bicycle paths are not useful for commuting

purposes, and a number, in fact, are dangerous because of visual blocks, dangerous corners, lack of maintenance, excessively tight curves, steep grades, poor pavement, etc. Bicycle access barriers need to be identified, such as rivers, interstate highways, canals, and industrial areas, and means to circumvent them need to be provided. Intersection design and rights-of-way requirements must be established.

The most obvious faults of bikeway planning and implementation activities to date are:

(1) design and construction of individual bikeway segments where they are most expedient and readily implemented, rather than in a systematic framework;

(2) leaving gaps in what should be continuous facilities; and

(3) placement of facilities on tortuous routings and avoidance of areas where solutions are difficult or necessarily involve relatively high (relative to other bicycle facilities) capital costs.

More effort must be devoted to developing means for safe and convenient bicycle passage through the bottlenecks and barriers to bike travel that are a common feature

of urban areas. Planners and designers have been guilty of devoting a vast portion of their attention to providing linear segments of bikeways that have low costs but with little utilitarian return, pose minimal implementation problems, and have high visibility for maximum public relations value while doing little to facilitate bicycle-borne mobility.

In addition to the provision of well-planned bicycle facilities, an essential part of a good utilitarian bicycle transportation program is the provision of a high-level of bikeway maintenance. An intensive and regular bikeway maintenance program is as essential for bikeways as it is for roadways. Poorly maintained bikeways can cause serious safety problems. Chuckholes, uneven pavement, and poor curb cuts create a safety hazard because of the bike's smaller, lighter wheels. Without regular cleaning most bikeways become unusable and hazardous. Sand, dirt, glass, vegetation, and snow accumulate on bikeways, forcing the cyclist onto the roadway, where he may face conflicts with auto traffic not expecting bicyclists in the main roadway. These hazards tend to make the cyclist's movements unpredictable, and creates safety problems for the bicyclists and motorists alike.

If these pitfalls are judiciously avoided, a well-designed and maintained bikeway system, oriented toward the bicycle as a true travel mode rather than a means of

recreation, can be expected to attract large numbers of new bicyclists and reinforce the use of the bicycle as an alternative to the automobile. Such shifts in travel behavior will reduce automotive VMT and contribute to the improvement of air quality.

D. BICYCLING EDUCATION AND SAFETY

Beyond the provision of needed facilities, the greatest need in supporting bicycling is to develop an appreciation of and commitment to bicycling safety by both bicyclists and motorists. Bicycle safety education should start at the earliest levels in the schools, and continue throughout the period of primary and secondary education, being integrated into the standard driver education programs in high school. At present, there are no standards of knowledge or competence for bicycle instruction, nor are there any regular bicycling safety courses integrated into standard curricula.

Motorists also need recurring education on the rules of the road applicable to bicycle safety, and on safe driving practices in traffic which includes bicycle traffic. Driver's education classes should emphasize bicycle safety, and driver's license testing should also include a test of bicycling safety knowledge. Motorists must come to learn that bicycle traffic has equal rights to the road; prominent

signing, such as the large signs posted in Washington, D.C., which read "BIKES HAVE EQUAL RIGHTS" are useful. Generally, motorists and bicyclists must learn how to travel on the same roadways in harmony with each other.

There is also a need for more regular and stringent enforcement of traffic laws concerning bicycles for both bicyclists and motorists. Stricter enforcement of the "rules of road" would enhance harmonious auto bicycle traffic, since cyclists and motorists would both behave in constant, predictable, complementary ways. Bicyclists (adults and children) especially have flagrantly ignored traffic laws, creating hazards for both themselves and motorists. Motorists are often ignorant of bicycle traffic rights, or simply fail to give cyclists proper leeway in traffic situations. Bicyclists are often afraid of automobile traffic because of fear of ignorant, inconsiderate, or oblivious motorists who present a very real threat to the cyclists' physical safety and well-being. Motorists generally do not like bicyclists on the road because of the often unpredictable movements of bicyclists and their too common failure to act in a recognizable, prescribed manner. Bicycle rules of the road must, thus, be constantly communicated to cyclists and motorists alike, and be strictly and vigorously enforced to create a more harmonious traffic environment.

E. BICYCLING AND TRANSIT

A means of potentially expanding the bicyclists travel radius is to link bicycling with transit use. By providing adequate storage facilities at major transit service points, such as park-and-ride facilities, an outstanding potential exists for development of feeder bicycle travel to the transit system.

It should be noted that some 95% of the Denver Metropolitan Area population resides within five miles of the RTD's major transit service centers, or "pulse points." This indicates that, potentially, many persons could travel relatively short distances by bicycle to the nearest transit center, and then use transit for connections throughout the metropolitan area. Bicycles can also provide both a feeder and distribution travel mode to and from transit lines if provision is made to transport bikes on buses. San Diego, California has experimented with multiple bike racks on its buses, and has demonstrated that the concept warrants further development.

To develop the potential of the bicycle/transit interface, it is recommended that the RTD incorporate innovative provision for bicycling at its major service

points. Included should be a major information program to publicize the potential advantages of bicycle/transit connections.

V. ROAD PRICING

As a potential measures to reduce automotive emissions, road pricing seeks to reduce automotive travel by imposing a cost directly on the motorist for driving on specific roadways or for entering certain areas. The road pricing techniques available fall broadly into two categories: imposition of roadway tolls; and 2), restriction of travel in specific areas to vehicles with special licenses or permits, for which a fee is charged.

Road pricing measures may have potential air quality benefits to the extent that they are able to result in area-wide VMT reductions and/or improve traffic flows. It has often been speculated that the air quality benefits of road pricing could be substantial, depending of course, on the severity of the pricing measures, the availability of other modes of transportation, the availability of alternative automobile routes, and the enforceability of the program.

Unfortunately, there has been little actual experience with the imposition of road pricing programs for air quality purposes, and consequently, almost no empirical before-and-after data exists on the effects of such measures. Some theoretical work has been

done which indicates that a road pricing program oriented only to peak period traffic is likely to have only minimal air quality benefits, compared to road pricing measures which affect all traffic.* It also appears likely that the road pricing concept is most applicable in areas where a substantial portion of the area's VMT is accounted for by trips to and from a limited number of relatively small, well-defined locations, or on a limited number of specific roadways.

While there is a long history of toll roads, bridges, and tunnels in the United States, the tolls on these facilities have been imposed to raise revenues to pay for the construction and/or operation of the facilities, rather than to reduce traffic flow. Indeed, the emphasis on such facilities is often to increase traffic flows to increase revenues. Thus, past experience with tolls does not provide much insight into the effectiveness of road pricing measures in improving air quality.

The most notable example of imposing fees or special licenses to enter certain districts is presented by Singapore. The city has established a supplementary licensing program to limit vehicles entering the Singapore CBD, where traffic congestion has become seriously disruptive. Access to the CBD during the morning rush

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* Joel L. Horowitz, U.S. EPA, "Pricing the Use of the Automobile to Achieve Environmental and Energy Goals," Transportation Research Bulletin, Special Report #181, published by the Transportation Research Board, National Academy of Sciences, 1978.

hour is permitted only to motorists who have purchased an expensive special permit and to commercial vehicles. The program is very strictly enforced, and has succeeded in significantly reducing traffic congestion. Preliminary evidence indicates that the restriction has also resulted in important reductions in air pollution as well, though this was not of primary concern. Available data shows that carpools to the CBD have increased by over 80% from before the restriction to shortly afterwards (i.e., from 2,100 to 3,900), and that transit partronage in the CBD area has increased by 10-15%.

Little or no analysis of the potential benefits and costs of establishing road pricing programs to improve air quality, nor of possible road pricing measures, has been conducted within the context of specific metropolitan areas in the United States. It is likely, however, that in an area such as the Denver Region, characterized by relatively dispersed moderate-to-low density development with a relatively small CBD and numerous other important activity centers, and with relatively unfettered physical access throughout the area, that design of a successful road pricing program would be technically more difficult than in many other areas, and perhaps impossible.

Public acceptance of road pricing in the Denver Region is also likely to be extremely low, especially with the virtually traditional aversion in Western States to the imposition of roadway tolls. (It should be noted that the

Denver-Boulder Turnpike was originally built as a toll road at a time when other sources of funding for such a facility, such as the Interstate Highway Program, were not available; the Turnpike's bonds were retired early and the tollgates removed in the mid-1960's. There are presently only two toll roads in Colorado, both private tourist attractions). Lacking well-documented technical information that demonstrates that very substantial air quality benefits can result from a road pricing program, and without practical experience with the design and operation of such programs in the United States, it is not likely that public attitudes will change toward road pricing, nor that the political leadership would or should be willing to advocate such programs.

Finally, it must be noted that, under existing Federal law, roadway tolls cannot be imposed on Interstate highways built under the Federal-Aid Interstate Program. If tolls are imposed on such facilities, which constitute the majority of key freeways in the Denver Region, the Federal share of the highway's construction costs must be paid back to the U.S. Treasury. Since the Federal Government pays for 90% of the cost of Interstate highways, the State of Colorado would be required to repay the Federal Government 90% of the cost of any Interstate facility on which tolls would be imposed. This would amount to hundreds of millions of dollars, and is far beyond the realistic fiscal capabilities of the State. (While a number of Interstate highways in the East and Midwest are toll roads, these were not built under the Interstate Program, but with state funds.)