

# **BICYCLE TRANSPORTATION FOR ENERGY CONSERVATION**

**Katie Moran**

**Mountain Bicyclists' Association, Inc.  
Denver, Colorado**

**Contract No. DOT OS-90092**



**MAY 1980  
TECHNICAL REPORT**

*This document is available to the U.S. public through the  
National Technical Information Service,  
Springfield, Virginia 22161*

**Prepared For  
U.S. DEPARTMENT OF TRANSPORTATION  
Office of the Secretary  
Washington, D.C. 20590**

## Disclaimer

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The U. S. Government assumes no responsibility for its content or use thereof.

1. Report No. DOT-P-80-092		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Bicycle Transportation for Energy Conservation Technical Report				5. Report Date May 1980	
				6. Performing Organization Code	
7. Author(s) Katie Moran				8. Performing Organization Report No.	
9. Performing Organization Name and Address Mountain Bicyclists' Association, Inc. 1290 Williams Street Denver, Colorado 80218				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. DOT-OS-90092	
12. Sponsoring Agency Name and Address U. S. Department of Transportation Office of Environment and Safety 400-7th Street, S. W. Washington, D. C. 20590				13. Type of Report and Period Covered Final Technical Report June 1979-May 1980	
				14. Sponsoring Agency Code DOT-P-20	
15. Supplementary Notes COTR: William C. Wilkinson, III P-20 (202)426-4414					
16. Abstract The study was mandated by Section 682 of the National Energy Conservation Policy Act of 1978. The study's objectives were to: (1) identify the obstacles to increased bicycle use; (2) develop a Comprehensive Bicycle Transportation Program (CBTP) to overcome these obstacles; (3) establish a target goal for bicycle commuting; and (4) determine the energy conservation of potential bicycle transportation. As part of this effort, specific action plans for implementing the CBTP were developed for the DOT, DOE, EPA, CPSC, DOI, USDA, and GSA, and for state and local governments and private sector organizations.  The study determined that 470,000 people commuted by bicycle in 1975 and that a reasonable goal for 1985 would be an additional 1.5 to 2.5 million bicycle commuters, with a 50-100% increase in other bicycle travel. If this goal is reached, it will result in a total energy savings of 16.4 to 23.5 million barrels per year by 1985.					
17. Key Words Bicycle transportation, energy conservation, bicycle programs, trip characteristics, commuting alternatives.			18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia, 22161.		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages	22. Price

## PREFACE

Due to the very short timeframe and comprehensive scope of this study, this report could not have been written without the significant contribution of several key individuals. William C. Wilkinson, the Contract Officer's Technical Representative, put in long hours developing the original design for the government contract and providing guidance and assistance throughout the project. William Ryan (Impact, Ltd.) and Larry Lucero (TransPlan, Inc.) each took on responsibility for major tasks in this study and contributed heavily to the preparation of this report. John Williams and Michael Huffaker participated in the development of objectives for the comprehensive program, and the following individuals donated their time to evaluate the importance of each of these objectives: Dick Rogers, Ron Thompson, Josh Lehman, Cathy Buckley, Ralph Hirsch, Ken Cross, Alex Sorton, John Allis, Bruce Burgess, Charles McCorkell, Mitch Tyson, Miriam Block, Malcolm Murray, Peter Koltnow, Tedson Meyers, Harry Shaw and James Matthews. The assistance of each of these individuals is sincerely appreciated.

# TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY . . . . .	1
A. Background . . . . .	1
B. Problem Definition. . . . .	2
C. Sources of Information. . . . .	2
D. Summary of Findings . . . . .	2
E. Recommendations . . . . .	4
F. Organization of This Report . . . . .	7
I. INTRODUCTION. . . . .	8
A. Background and Purpose. . . . .	8
B. Methodology . . . . .	9
II. CURRENT BICYCLE USE IN THE U.S. . . . .	15
A. Introduction. . . . .	15
B. Characteristics of Bicycle Use . . . . .	15
C. Obstacles to Increased Bicycle Use. . . . .	57
D. Summary . . . . .	62
III. COMPREHENSIVE BICYCLE TRANSPORTATION PROGRAM. . . . .	63
A. Introduction. . . . .	63
B. Objectives. . . . .	63
C. Critical Factors. . . . .	64
D. Program Elements. . . . .	67
E. Summary . . . . .	77
IV. POTENTIAL USE . . . . .	79
A. Introduction. . . . .	79
B. Potential Commuter Use. . . . .	79
C. Potential Use of the Bicycle for Other Trip Purposes. . . . .	82
D. Potential Energy Savings. . . . .	82
E. Potential Air Quality Improvement . . . . .	85
F. Summary . . . . .	88

V.	RECOMMENDED ACTIONS. . . . .	90
	A. Introduction . . . . .	90
	B. The Role of the Federal Government . . . . .	90
	C. State Government Involvement . . . . .	101
	D. Local Government Involvement . . . . .	104
	E. Private Sector Involvement . . . . .	107
	F. Cost/Benefit Discussion. . . . .	112
	G. Summary. . . . .	113

APPENDIX A: SELECTED BIBLIOGRAPHY

APPENDIX B: IDENTIFIED RESEARCH NEEDS

## EXECUTIVE SUMMARY

### A. Background

The National Energy Conservation Policy Act (PL-95-619) required the Department of Transportation to conduct a study of bicycle transportation for energy conservation. The text of Section 682 is as follows:

#### Section 682. Bicycle Study

"(a) The Congress recognizes that bicycles are the most efficient means of transportation, represent a viable commuting alternative to many people, offer mobility at speeds as fast as that of cars in urban areas, provide health benefits through daily exercise, reduce noise and air pollution, are relatively inexpensive, and deserve consideration in a comprehensive national energy plan."

"(b) Not more than one year after the date of enactment of this Act, the Secretary of Transportation shall complete a study of the energy conservation of potential bicycle transportation, determine institutional, legal, physical, and personal obstacles to increased bicycle use, establish a target for bicycle use in commuting, and develop a comprehensive program to meet these goals. In developing the program, consideration should be given to educational programs, federal demonstrations, planning grants, and construction grants. The Secretary of Transportation shall submit a report to the President and to Congress containing the results of such a study."

This report summarizes the work conducted by Mountain Bicyclists' Association, Inc. as background for this report.

One of the objectives of this report is to identify a reasonable target for increased bicycle use. While there is an underlying presumption that the bicycle can make a contribution to the nation's energy conservation program, prior to this study there has not been any systematic analysis of the future of bicycle transportation in this country. This study has been approached with no preconceived notions or biases concerning the energy conservation potential of bicycle transportation or the design of the comprehensive program to increase bicycle use. Program and policy recommendations are based on an analysis of the best information that was available or could be developed during the period of the study.

## B. Problem Definition

The issues underlying the implementation of a comprehensive program to increase bicycle use focus on four questions:

1. What are the major obstacles to widespread use of the bicycle?
2. What steps are necessary to overcome these obstacles and increase the use of the bicycle as an integral mode of transportation?
3. What is a reasonable target for increasing the level of bicycle use?
4. What are the energy conservation benefits of increased bicycle use?

Our analysis and this report were designed to answer these questions.

## C. Sources of Information

Sources of information included existing literature, the 1975 Travel to Work Supplement to the Annual Household Survey conducted by the Bureau of the Census, correspondence with state and local bicycle program specialists, a request for Information and Public Comment issued by the Department of Transportation in the Federal Register<sup>1</sup>, and a group decision-making process involving leaders in transportation planning, private industry and public administration. A selected bibliography is included as Appendix A.

## D. Summary of Findings

### 1. Obstacles

We find that all obstacles or constraints can be organized into two main categories--those that prevent or discourage a person from choosing to ride a bicycle for transportation, and those that constrain an institution from becoming effectively involved in bicycle transportation. The primary

---

<sup>1</sup>DOT Notice #79-1, Federal Register, Volume 44, No. 114, 12 July 1979.



obstacles to increased bicycle use for transportation are as follows:

Personal:

- Low level of awareness and acceptance of bicycle transportation (by potential cyclists and motorists),
- Inability to bicycle safely and efficiently,
- Lack of provisions for cycle use (on existing streets, special bicycle facilities, bicycle parking availability), and
- Other disincentives (e.g., lack of knowledge about good routes).

Institutional:

- Low level of awareness and acceptance of bicycle transportation,
- Lack of skills and knowledge relative to bicycle transportation,
- Inadequate funds, and
- Lack of communication and coordination.

2. Potential Use

Bureau of the Census figures show that an average of 470,000 people commuted to work by bicycle on any given day in 1975. This amounted to approximately 0.6 percent of all commuters. The 1975 data on commuting was analyzed to determine how many people might shift to bicycles for their trip to work if the identified obstacles were reduced or eliminated. When factors such as distance, time, auto dependency, physical limitations and environmental are considered, we estimate that 3.8 million workers could have commuted by bicycle in 1975 compared to the 470,000 who actually did commute by bicycle.

3. Target Goal and Energy Conservation Potential

In view of the foregoing, we propose a target goal of 1,000,000 to 2,000,000 new bicycle commuters by 1985. Further, we estimate that, if this goal is achieved, the use of bicycles for other transportation purposes (e.g., shopping) will increase 50 to 100 percent. We calculated the potential reduction in automobiles by estimating how many of these

new bicycle riders formerly used an auto for the same trip. Using this figure, we estimate that, if the target goal is achieved by implementing the Comprehensive Bicycle Transportation Program, the resulting fuel savings from bicycle transportation will be in the range of 16 to 24 million barrels per year.

## E. Recommendations

### 1. Objectives

Based on our analysis of the obstacles to increased bicycle use, we developed a Comprehensive Bicycle Transportation Program, whose implementation should result in achieving the target goal by 1985.

In order to overcome the identified obstacles and increase the use of bicycles for transportation a comprehensive program should have three major objectives.

#### Program Objectives

- To improve operator awareness of and competence in bicycle transportation,
- To improve the transportation system relative to bicycling, and
- To increase institutional and professional responsiveness to bicycle transportation.

### 2. Program Elements

We recommend that a Comprehensive Bicycle Transportation Program be implemented over the next five years. Our study indicates that, in order to increase bicycle transportation, the program should include the following elements:

#### Comprehensive Bicycle Transportation Program

##### a. Operator's Awareness and Competence

- Comprehensive bicyclist education/training available to all interested adults to increase cycling proficiency,
- Public awareness programs to acquaint the public with the benefits of cycling and to increase the acceptance of the bicycle as a mode of transportation,

- Motorist information program to improve drivers' understanding of cycling and ability to share the road with cyclists,
- Selective enforcement of traffic laws to improve bicycle safety, and
- Bicycling incentives to increase bicycle use.

b. Transportation System Characteristics

- Elimination of roadway surface and design hazards to increase cyclists mobility and safety,
- Improve bicycle access by reducing effects of "bottlenecks" (i.e., bridges), and
- Provision of bicycle parking to accommodate more widespread use.

c. Institutions and Professionals

- Increased funding to expand bicycle program activities,
- Standards and guidelines to improve the quality of bicycle programs,
- Integration of bicycle transportation into regular planning activities to provide for joint development,
- Coordination of bicycle transportation activities to increase effectiveness and efficiency,
- Increase awareness and acceptance of bicycle transportation by transportation professionals, and
- Increase knowledge and understanding of bicycling and bicycle programs among transportation and related professionals.

d. Policy and Actions

Federal. Within the Federal government the lead role in implementing the Comprehensive Program should be taken by the Department of Transportation. Upon consideration of the results of this study, we believe that it is appropriate to redefine the Department's

bicycle policy to provide for an expansion of our responsibilities in implementing the proposed Comprehensive Bicycle Transportation Program:

Proposed Department of Transportation Bicycle Policy:

- To promote the safe, increased use of bicycles for transportation,
- To integrate bicycle transportation into all appropriate Departmental programs activities, and
- To require the consideration of bicycle use in all appropriate DOT-funded transportation projects.

Within the Department, responsibility for implementing this policy should be distributed among the administrations as follows:

- Federal Highway Administration--general promotional activities; all highway and special bicycle facility-related projects and programs,
- National Highway Traffic Safety Administration--bicycle safety programs; education, training and enforcement programs for motorists and bicyclists,
- Urban Mass Transportation Administration--bicycle/mass transit interface program,
- U. S. Coast Guard--integration of bicycle considerations in the bridge permit review process, and
- Office of the Secretary--policy development and overall program coordination, review and evaluation.

The Department of Transportation should coordinate its actions with the other appropriate Federal agencies whose roles are as follows:

- Environmental Protection Agency--promotion of bicycle transportation as an air quality improvement strategy;
- Department of Energy--promotion of bicycle transportation as an energy conservation measure;
- Department of the Interior--implementation of programs to encourage bicycle use;

- Consumer Product Safety Commission--bicycle design regulation and bicycle safety education for consumers;
- General Services Administration--provision of secure bicycle parking at all Federal installations.

State. State governments will need to maintain an involvement similar to that of the Federal government. State organizations will work in partnership with the Federal government and local governments by:

- allocating Federal funds to state and local bicycle programs,
- initiating large-scale statewide programs (e.g., curricula development/public information/bicycle registration),
- developing statewide transportation, energy conservation, and air quality plans which include bicycle considerations,
- enacting bicycle-related traffic laws,
- designing highway projects to accommodate bicycles,
- encouraging local bicycle program implementation, and
- educating motorists on bicyclists' rights, etc.

Local. Local governments will continue to be responsible for the majority of activities which directly affect bicyclists and bicycle transportation. These actions will include:

- planning for the needs of bicyclists,
- enacting and enforcing bicycle-related ordinances (traffic, zoning, etc.),
- improving and maintaining roadways for cyclists,
- constructing/installing bicycle facilities (including bicycle parking), and
- conducting bicycle encouragement and education/training programs.

Private. Private sector involvement will range from local bicycle clubs offering cyclists training programs, and private industry providing parking and shower facilities, to professional associations

issuing "recommended practices" to their members and the bicycle industry calling greater attention to the bicycle as a transportation vehicle.

#### F. Organization of This Report

This report is divided into five chapters: Chapter I describes the background, purpose and methodology of the study. Chapter II summarizes the current level of bicycle use and describes the major obstacles to increased bicycle use. Chapter III presents the recommended elements of the Comprehensive Bicycle Transportation Program. Chapter IV establishes the target goal for increased bicycle use and estimates the energy conservation and air quality benefits of achieving that goal. Finally, Chapter V describes the policies and actions we recommend for the Federal, state, local and private sector actors involved in implementing the Comprehensive Program. The Appendices contain a selected bibliography and a listing of research needs in the field of bicycle transportation.

## I. INTRODUCTION

### A. Background and Purpose

The bicycle, a simple but efficient mode of transportation, offers society the potential of increased energy conservation, improved air quality, and better personal health. Its usefulness as a transportation alternative in the current energy crisis has been recognized by the Congress and the President, leading to its inclusion in the National Energy Conservation Policy Act (PL 95-619) of 1978. Section 682 reads as follows:

#### Section 682. Bicycle Study

"(a) The Congress recognizes that bicycles are the most efficient means of transportation, represent a viable commuting alternative to many people, offer mobility at speeds as fast as that of cars in urban areas, provide health benefits through daily exercise, reduce noise and air pollution, are relatively inexpensive, and deserve consideration in a comprehensive national energy plan."

"(b) Not more than one year after the date of enactment of the Act, the Secretary of Transportation shall complete a study of the energy conservation of potential bicycle transportation, determine institutional, legal, physical, and personal obstacles to increased bicycle use, establish a target for bicycle use in commuting, and develop a comprehensive program to meet these goals. In developing the program, consideration should be given to educational programs, federal demonstrations, planning grants, and construction grants. The Secretary of Transportation shall submit a report to the President and to Congress containing the results of such a study."

As part of their effort to satisfy this requirement, the Department of Transportation contracted with Mountain Bicyclists' Association to analyze current bicycle conditions, and to make recommendations concerning what is needed to increase bicycle use in the U.S.

The need for such a study is based on a problem that has plagued bicycling for years. Bicycle transportation has generally been overlooked as a legitimate mode of transportation and as part of the solution to the nation's energy and air pollution problems. A cause, or perhaps a result of this situation, is the extreme shortage of available data on the extent and nature of bicycle use in the United States. Without this data, bicycle

transportation advocates have had difficulty documenting their claims of the societal benefits which can accrue through increased bicycle use. Without this documentation, institutional decision-makers have been reluctant to commit public funds to encourage an "unproven" transportation mode. A vicious circle has resulted in which governmental "neglect" has discouraged or actually prevented potential riders from bicycling regularly, which in turn has provided the justification for continued institutional non-action.

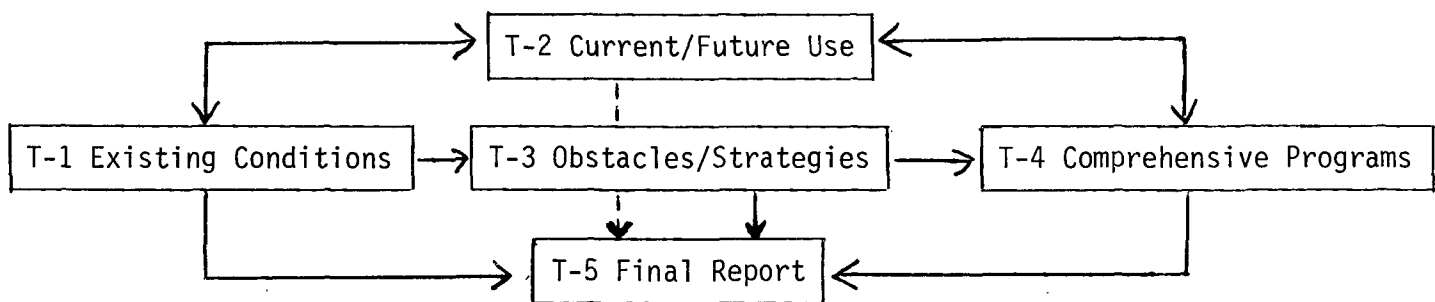
The mandate expressed in Section 682 provides the unique opportunity to break this circle by:

- documenting for the first time the actual levels of bicycle use in the U.S.,
- providing supportable estimates of future levels of purposeful bicycling using mathematical techniques accepted by the transportation community,
- organizing the myriad descriptions of the problems that face bicyclists into a logical framework, and
- developing a comprehensive national bicycle program specifically designed to increase the use of bicycles for transportation.

#### B. Methodology

Our approach to this study was organized into four major tasks. Figure I-1 shows the interrelationship of these tasks.

Figure I-1. Task Methodology





These tasks were designed to allow us to answer four critical questions:

1. What are the major obstacles to widespread use of the bicycle?
2. What steps are necessary to overcome these obstacles and increase the use of the bicycle as an integral mode of transportation?
3. What is a reasonable target for increasing the level of bicycle use?
4. What are the energy conservation benefits of increased bicycle use?

#### Question 1

The first step in defining the existing conditions affecting bicycle use was a review of the pertinent literature. National bicycle studies from the following sources were consulted: the National Highway Traffic Safety Administration (NHTSA) Regional Bicycle Workshops; the Department of Transportation (DOT) Community Bicycle Programs; the DOT Study of Demand Incentives for Non-Motorized Transportation; the NHTSA Bike-Ed 77 Conference; the Environmental Protection Agency (EPA) Bicycle Information Document; the NHTSA Bicycle/Motor Vehicle Accident Study; and the Bicycle Federation's Feasibility Study of a National Bicyclist Training Program. Selected articles from Bicycle Forum and Traffic Quarterly also were reviewed, in addition to papers presented at the meetings of Metropolitan Association of Urban Designers and Environmental Planners (MAUDEP) and the Transportation Research Board (TRB). This investigation also examined documentation from state and local programs and consulted literature on the general topics of transportation planning, public administration, and attitude change theory.

As a second step, a request for public comment was placed by DOT in the Federal Register<sup>2</sup>. In response, over five hundred letters from the general public, bicycle specialists, and governmental agencies, particularly local planning offices, were received.

Third, conversations and meetings were conducted with key individuals involved in the development and operation of bicycle programs. More

---

<sup>2</sup>Ibid.

specifically, these included the mid-year meeting of the Transportation Research Board Committee on Bicycling, the annual Bicycle and Pedestrian Conference of the Metropolitan Association of Urban Designers and Environmental Planners, and the annual convention of the League of American Wheelmen.

As a final step in defining existing conditions of bicycle transportation in the United States, we consulted data from the following studies to determine current levels of bicycle use: the DOT (U.S. Census) Travel to Work Survey, 1975; the Manhattan Commuter Bicycle System Study, Edwards and Kelsey, 1977; the Washington, D. C. Regional Bikeway Study, Deleuw, Cather and Company, 1977; the Bicycling in Pennsylvania Study, Barton-Aschman Associates, 1976; and the Bicycling in Tennessee Study, Barton-Aschman Associates, 1974. It should be noted that "current" levels of use referred to in this study reflect the bicycling volume identified for 1975. It was not possible to update these data during the course of this study.

## Question 2

The second question concerning what is required to increase the level of bicycling in the U.S., involved a multi-stage process of:

1. identifying obstacles to bicycle use;
2. translating these obstacles into measurable objectives for a Comprehensive Bicycle Transportation Program;
3. identifying and prioritizing the sub-objective for each program objective;
4. developing specific strategies to accomplish each sub-objective and evaluating the effectiveness of these strategies;
5. synthesizing them into a Comprehensive Bicycle Transportation Program; and
6. developing action plans for implementing the Comprehensive Program.

The first step in the process, obstacle identification, was accomplished by assimilating input from both experts and the general public. The obstacles identified are discussed in Section II of this report. These obstacles were then organized into a logical framework

to highlight the role they play in bicycle use and then translated into objectives.

Identifying the sub-objectives of the Comprehensive Program was accomplished at a three-day brainstorming session with a small group of bicycling experts. The objective of this session was to identify all the factors that should be considered in the development of a comprehensive bicycle program. These factors, or sub-objectives, were then organized into a hierarchical structure designed to represent the totality of what could be included in a bicycle program and provide a common basis for discussion. (This structure is shown in Figure III-1.)

Since a reasonable program could not attempt to do everything, it was necessary to establish priorities for the various objectives and sub-objectives. The hierarchical structure was sent to two groups, one representing bicycle program specialists and the other institutional decision-makers, for them to evaluate the relative criticality of each item on the structure in increasing bicycle use. The process used was the Worth Assessment Method, a decision analysis tool developed for the Air Force Systems Command in the 1960's.<sup>3</sup> This process allowed us to establish a concensus about the criticality of each objective and sub-objective, and to evaluate the level of agreement among experts.

Once the objectives and sub-objectives were organized and prioritized, alternative strategies for achieving specific objectives could be developed and synthesized into a comprehensive program. Suggestions for strategies for addressing obstacles were taken from a number of sources: (1) the general public, through use of the DOT request in the Federal Register; (2) experts who completed the workbooks; and (3) study team members, who

---

<sup>3</sup>For more information on the Worth Assessment process see: Sage, A. P., Methodology for Large-Scale Systems, New York: McGraw-Hill, 1977; or Farris, D. R. and Sage, A. P., "On Decision-Making and Worth Assessment," International Journal of Systems Sciences, Volume 6, (1975), pp. 1155-1178.

reviewed the literature in search of additional strategies. More than 500 strategies were identified. Suggested strategies were then categorized according to the objectives and sub-objectives that they addressed in the hierarchical structure. The original list of obstacles also served as a reference point to ensure that all critical problems were addressed.

The final stage in the process was the assessment of the effectiveness of each strategy in accomplishing its objective. Strategies which were determined to be effective in accomplishing the most critical objectives were synthesized into a recommended Comprehensive Bicycle Transportation Program. Specific action plans were then developed to describe the roles of the various actors involved in the implementation of this comprehensive program.

### Question 3

The third question addressed in this investigation concerns the potential levels of purposeful bicycle use which could be reached in 1985.<sup>4</sup> In this area it is necessary to rely on "best professional judgment" and on the reliable data available.

Our original intention was to develop a Logit model of modal split for short access trips<sup>5</sup> to reflect the influence of time, cost and personal perceptions on the choice of bicycling over other modes. This model hypothesizes that an individual's mode choice is the result of a logical process of comparing the attributes of the modes available for any trip. This approach required a large body of disaggregate data on work trips for every mode as well as on personal attitudes toward bicycling relative to other modes. Data inadequacies, however, particularly on personal attitudes, prevented us from pursuing this model.

The approach we actually used for this study focused first on the bicycle commuting trip, as this was the trip purpose highlighted by Congress and for which the most complete data were available. We

---

<sup>4</sup>We chose 1985 as the target year because we believe it will take five years to fully implement the Comprehensive Program.

<sup>5</sup>See "A Multimodal Logit Model of Modal Split for a Short Access Trip," Paul Inglis, DeLeuw Cather and Company of Canada, Ltd., publication of this paper sponsored by Committee on Social, Economic and Environmental Factors of Transportation.

determined the maximum number of automobile and public transit commuters who could possibly switch to the bicycle, by analyzing the effect of such factors as:

- distance and speed of commute trip,
- need for automobile during workday,
- physical limitations of potential cyclists, and
- environmental conditions in the regions in which the work trip will be made.

Assuming that other factors may prevent many of these possible bicyclists from choosing the bicycle, we reduced the number of bicycle commuters by half in order to establish a target goal for bicycle commuting.

To the fullest extent possible, a similar approach was used for other trip purposes, such as school, personal business, and recreation. The estimates for increased use were expressed in ranges representing the effects of limited to full-scale implementation of the Comprehensive Program.

#### Question 4

The final question to be addressed was the assessment of impact this increased level of bicycle use would have on such factors as energy conservation and air quality. Because of the Congressional interest expressed in the National Energy Conservation Policy Act, the energy conservation impact is of primary importance.

The energy conservation potential of bicycle transportation was determined by calculating the number of daily miles of automobile travel diverted to bicycle travel, and establishing an average fuel economy for short trips in 1985. The number of miles diverted divided by the average fuel consumption (mpg) will yield the daily gasoline savings from increased bicycle use. This figure should then be added to current gasoline savings created by existing bicycle use in order to determine the total contribution which can be made by bicycling as an energy conservation strategy.

## II. CURRENT BICYCLE USE IN U. S.

### A. Introduction

The purpose of this chapter is to provide an overview of bicycle use in the U.S. We will focus first on a description of bicycle trip characteristics and the state-of-the-art in bicycle program development, and then present a synthesis of the factors that most directly inhibit a nationwide increase in bicycle use.

It is important to understand the general level of knowledge about bicycling when this study was begun. The common statement about bicycling statistics was that there are 95 million bicycles in the U. S. Beyond that, people generally relied on eyeball estimates of the number of bicyclists they saw on the street. When it came to attitudes about bicycling, people generalized from their own personal experiences. In other words, if an individual does not like riding in traffic, he or she assumes that no one likes to ride in traffic. Since bicycling has never been accepted as a professional discipline, it is understandable that everyone can perceive themselves as experts.

We are at the point in the development of bicycle transportation where we need better experts with more useful data. In the sections that follow, we have attempted to shed more illumination on exactly what is going on in bicycling in the U. S.

### B. Characteristics of Bicycle Use

We will organize our discussion under four headings:

- Characteristics of Trips,
- Characteristics of Riders,
- Environmental Conditions, and
- Institutional Involvement.

## Characteristics of Trips

Values for bicycle trip characteristics were determined in this study by bringing together related data from a variety of sources, including:

- 1975 Travel to Work Supplement to the Annual Housing Survey, U. S. Census;
- Manhattan Commuter Bicycle System Study, Edwards and Kelsey, 1977;
- Bicycling in Pennsylvania, Barton-Aschman Associates, 1976;
- Bicycling in Tennessee, Barton-Aschman Associates, 1974; and
- Washington, D. C. Regional Bikeway Study, DeLeuw Cather and Company, 1977.

The general process we followed was to identify one relatively solid national estimate and then use that number as a base for calculations developed from a variety of local studies. We chose work trips as our starting point because of the availability of the Census data on personal transportation to work.

The U. S. Census survey of 68,000 respondents estimated that .6% of all daily work trips (471,000) were made by bicycle in 1975.<sup>6</sup> The principal mode of transportation for all workers is shown in Table II-1.

While Table II-1 provides figures based on national data, interesting regional variations should be noted. Table II-2 illustrates the regional variation in bicycle commuting levels. The major finding in this breakdown is the considerably higher level of bicycle use in the Western region--twice the national average.

---

<sup>6</sup>Several limitations of the Census data should be noted at this point. The survey included respondents 14 years and older, resulting in the inclusion of some school trips in the total estimate of commute trips. The Census data do not include people living in dormitories or barracks, thus eliminating a potentially large segment of the bicycling population--college students.

Table II-1  
Principal Mode of Transportation to Work  
 (All Workers-1975)

Mode of Transportation	Percent of Trips Served	Mean Travel Time (minutes)	Mean Travel Distance (miles)
Drives Alone	67.4	17.8	8.3
Carpool	20.1	23.2	11.4
Mass Transportation	6.0	40.2	9.3
Taxicab	0.2	13.2	2.4
Bicycle	0.6	12.1	1.4
Motorcycle	0.4	16.0	7.5
Walk	4.9	8.7	0.1
Other Means	0.4	29.5	3.9
All Modes	100.00	19.9	3.5

Table II-2  
Bicycle as Principal Mode of Transportation to Work  
 (Regional Considerations)

Region	Percent of Work Trips Served	Mean Travel Time	Mean Travel Distance
Northeast	0.4	13.1	1.3
North Central	0.7	10.3	1.1
South	0.3	10.9	1.2
West	1.2	13.8	1.7



With these data on bicycle commuting as our starting point, we moved on to consider what percentage of all bicycling trips, the work trip represented, and the average trip length for each trip purpose. For our purposes the data developed in the Tennessee, Pennsylvania, and Washington, D. C. Bikeway Studies were selected as representative of the U. S. as a whole. The results of our calculations are shown in Table II-3.

Table II-3  
Average Daily<sup>7</sup> Bicycle Trips in the U.S. (1975)<sup>8</sup>

Trip Purpose <sup>9</sup>	% of All Bike Trips	No. of Trips (1,000)	Average Trip Length (miles)	Millions of Miles of Travel
Work	5	940	1.4	1.3
School	15	2,820	2.3	6.5
Personal Business	17	3,196	1.5	4.8
Social	17	3,196	1.5	4.8
Recreation	18	3,384	2.5	8.5
Neighborhood	28	5,264	1.5	7.9
All	100	18,800		33.8

<sup>7</sup>"Daily" in this study refers to a year-round weekday average.

<sup>8</sup>It is important to note that these figures are for 1975. Although there are indications that bicycle use has increased since 1975, there are no data sources comparable to the Census survey on which to base an updated figure.

<sup>9</sup>The trip categories are those used by Barton-Aschman Associates in their study of Bicycling in Pennsylvania. For the purposes of this study, Recreational and Neighborhood Riding will be considered to be non-purposeful, non-destinational while the remaining four categories will be considered purposeful. This distinction is made primarily because of the emphasis placed by Congress on energy conservation. It is assumed that there is minimal gas savings accrued by children's neighborhood cycling or by adult's cycling purely for the sake of cycling.

## Characteristics of Riders

It should be noted that the number of bicycle work trips differs from the earlier figure of 471,000 bicycle commuters. Each commuter makes two trips per day, to and from work. The same would hold for school, personal business and social trips. Recreation and neighborhood riding are considered non-destinational; therefore the number of these trips would correspond directly to the number of riders. This means, therefore, that there are 13.7 million daily bicycle riders in the U.S.

We were limited to the Census data in our analysis of sex and age of bicycle riders because this is the only data source we were able to find which confined itself to individuals actually making a trip, rather than persons answering for an entire household or who own a bicycle but may use it only occasionally.

Sex. There are slight differences identified in the Census data between male and female levels of bicycle use. The mean travel time for males is 12.3 minutes over a mean distance of 1.4 miles as compared to a mean travel time for females of 11.5 minutes over a mean distance of 1.3 miles.

Among males, bike work trips account for 0.8% of all work trips, but only 0.3% among females. In absolute numbers the males account for over 75% of the bicycle work trips.

Age. The bicyclist commuter has the lowest median age of any other commuter. Table II-4 shows the median age of commuters by mode of work trip.

Table II-5 illustrates the age distribution for those who commute by bicycle. The most significant point is the overrepresentation of bicyclists in the younger age categories. This is particularly notable for 20-24 year old females. It is also interesting to note the double peak for male bicyclists at 16-19 and 24-34.

Income. The bicycle has the lowest median rider income of any of the modes included in the Census Data, as illustrated in Table II-6.

Table II-4

Age of Commuter by Mode of Work Trip  
(U.S. Census Survey)

Median Age

<u>Mode</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
Drives Alone	37.8	35.9	37.1
Carpool	34.0	35.0	34.4
Mass Transportation	38.7	37.6	38.2
Taxicab	49.2	49.6	49.5
Bicycle	21.9	23.2	22.5
Motorcycle	26.8	21.7	26.5
Walk	34.4	36.4	35.4
Other Means	35.5	35.7	35.6
All Modes	36.8	35.8	36.5

Table II-5

Daily Bicycle Work Trips by Age  
(U.S. Census Survey)

Age Group

	14/15	16/19	20/24	25/34	35/44	45/54	55/64	65+	Median Age	Total
--	-------	-------	-------	-------	-------	-------	-------	-----	------------	-------

MALE WORKERS

% of Bike Work Trips	19.9	22.9	14.7	25.6	8.4	6.3	1.6	0.6	21.9	100.0
% of Total Work Force	0.6	5.4	12.0	27.0	20.0	19.5	13.0	3.0	37.1	100.0

FEMALE WORKERS

% of Bike Work Trips	6.8	11.7	41.7	16.5	13.6	6.8	2.9	0.0	23.2	100.0
% of Total Work Force	0.7	7.0	15.0	24.2	19.0	19.0	12.0	3.0	36.1	100.0

ALL WORKERS

% of Bike Work Trips	17.2	20.3	20.8	23.5	9.5	6.4	1.9	0.4	22.5	100.0
% of Total Work Force	0.7	6.0	13.0	26.0	20.0	19.5	13.6	3.0	36.7	100.0

Table II-6

Income of Commuter by Mode of Work Trip  
(U.S. Census)

Median Income

<u>Mode</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
Drives Alone	\$11,489	\$5,569	\$9,090
Carpool	10,365	5,137	7,363
Mass Transportation	11,181	5,707	7,758
Taxicab	9,653	4,184	4,786
Bicycle	3,087	1,955	2,723
Motorcycle	7,935	3,224	7,787
Walk	6,468	3,390	4,658
Other Means	8,327	2,815	5,801
All Modes	\$11,047	\$5,319	\$8,309

However, these data include all respondents down to the age 14, which weights the median toward the lower end of the income range.

A mean income for bicycle riders over 16 years of age was calculated by subtracting the product of (bicycle riders ages 14-15) x (mean income of workers ages 14-15) from the product of (all bicycle riders) x (mean income for bicycle riders). The difference of these two products was then divided by the number of bicycle riders over age 16 to give a mean income for bicycle riders over age 16.

To calculate percentage of bicycle work trips in each income category for workers over 16 years of age, an assumption was made about which income category the age 14-15 workers would fall into. From the Census data on earnings by age, it appears that a valid assumption to make is that about 15% of workers ages 14-15 are without income and the remainder (85%) would be in the \$1-2,000 earnings category. After subtracting the workers' ages 14-15 from these two income categories, new percentages were then calculated for all income categories for bicycle riders over age 16.

The results of these calculations are shown in Table II-7.

Personal Attitudes. The demographic characteristics of bicycle commuters, however, do not provide much insight into what bicyclists and non-bicyclists feel about bicycle transportation. It has been argued that bicycling differs from other transportation modes because of the heavy influence of personal attitudes on mode choice. It is theorized, especially by bicycle enthusiasts, that attitudes about bicycling strike chords much deeper in the human psyche than do considerations of time and cost. This may or may not be true. In any event, it would be foolish to ignore the varied attitudes towards bicycling that exist among cyclists and the general public. These attitudes may not only influence an individual's mode choice, but they may also determine the nature of an institutional response to bicycling or perhaps the style in which a motorist interacts with the cyclist he or she passes on the street.

The response to the DOT Notice in the Federal Register to solicit comments for this study provided a litany of the good things about bicycling. Most of those who responded were themselves bicyclists. According to those who commented, bicycling is good, enjoyable exercise. People feel healthier

Table II-7

Daily Bicycle Work Trips by Earnings

16+ Age Groups Only

	<u>Total</u>	<u>Without Income</u>	<u>Less Than \$2,000</u>	<u>\$2,000- 4,000</u>	<u>\$4,000- 6,000</u>	<u>\$6,000- 8,000</u>	<u>\$8,000- 10,000</u>	<u>\$10,000- 12,000</u>	<u>\$12,000- 15,000</u>	<u>\$15,000- 20,000</u>	<u>\$20,000- 25,000</u>	<u>\$25,000 or more</u>	<u>Mean Income</u>
<u>Male Workers</u>													
Percent	100.0	5.7	28.7	14.5	6.4	12.8	6.4	4.4	12.5	5.7	1.7	1.0	\$6,554
<u>Female Workers</u>													
Percent	100.0	11.5	41.7	19.8	11.5	6.3	4.2	2.1	1.0	2.1	0.0	0.0	3,032
<u>All Workers</u>													
Percent	100.0	7.2	31.8	15.9	7.9	11.3	5.9	3.8	9.5	4.6	1.3	0.8	\$5,733

when they ride regularly. It provides a strong feeling of independence and personal accomplishment. "I got there under my own steam."<sup>10</sup> Bicycling provides a way back to nature and all the good things in life. "You can smell the flowers and take time to say 'hi!' to your neighbors." Bicycling is an activity the family can do together, providing memories to share. It provides an easy outlet for one's social conscience. "I am personally doing something to clean up the air...to save energy...to make my city a nicer place to live." On a more practical side; it's cheap transportation. Miles ridden on a bike are dollars not spent for gasoline, parking fees, and auto repairs. Regular use of a bicycle can eliminate the need for a second car.

Unfortunately when respondents to the Federal Notice compared the benefits of bicycling with the problems, the problem list was always longer. The biggest problem frequently mentioned by a wide variety of respondents was fear. Many people are afraid to bicycle because they know they will be seriously hurt if they get hit by a car. Bicycling on the street appears too risky to a lot of people--bicyclists and non-bicyclists alike. But as bicycling experience increases, the cyclist becomes more confident of his/her ability to control the vehicle under a variety of situations. Total fear is replaced by an awareness of the hazards associated with bicycling and a constant state of alertness to accident-causing situations.

Bicyclists generally are frightened of motorists even though they themselves frequently operate a motor vehicle. In the Federal Register comments, in a recent San Diego study on bicycle commuting<sup>11</sup>, and in the Barton-Aschman survey,<sup>11a</sup> problems with motorists are cited as major disincentives to bicycling. In the Barton-Aschman study, 56.5% agreed with the statement "Going by bicycle to work is dangerous because motorists are inconsiderate of bicyclists."

Underlying bicyclists' fear is a widespread belief that bicycles do not belong on the road because streets are for automobiles. There is a

---

<sup>10</sup> Statements in quotations were taken from the letters received by the DOT.

<sup>11</sup> Bicycle Commuting in San Diego Region, prepared by Planning/Architecture/Environmental Design for the Comprehensive Planning Organization of the San Diego Region, 1977.

<sup>11a</sup> Barton-Aschman Associates, A Study of Demand Incentives for Non-Motorized Transportation, FHWA, Washington, D. C., 1979. This study involved a household survey in neighborhoods of five U.S. cities.



strong sense that bicycles cannot compete with cars and therefore should be as far removed from auto traffic as possible. The testimony of experienced cyclists that operating in traffic is perhaps demanding but not necessarily dangerous, has little impact on the novice cyclists because the skill differential between the two groups is so great. Experienced cyclists view themselves as legitimate road users; novice cyclists view themselves as "accidents waiting to happen." They operate their bicycles as if they are second-class citizens about to engage the wrath of automobile drivers.

Perhaps at the root of the traffic status problem with bicycles is the fact that for the past fifty years bicycles have been children's toys. It is only with the advent of the 10-speed bicycle that adults have taken to bicycling in any numbers. It is generally accepted as a recreational vehicle only. Very few people have any sort of identity/maturity crisis when they hit the bike trail for a Saturday afternoon ride; the crisis comes when they contemplate arriving at work on a bicycle. There is a real social status problem associated with cycling. It can be hard to maintain a "macho" image when the norm for "macho" is a sleek, gas-guzzling car. It isn't easy to look professional with your pants leg rolled up to protect it from the chain.

If a prospective bicyclist can endure the slings and arrows of social criticism, and is capable of facing rush-hour traffic on his or her bicycle, there are still other negative attitudes that are likely to develop and discourage future cycling. Many people believe it's just too much work to bicycle. It takes real physical effort to crank the pedals up a hill. This alone discourages large numbers of potential cyclists. 45.8% of those surveyed for the Barton-Aschman study agreed with the statement, "Traveling to work by bicycle is tiring."

Bicycling does not appear to be convenient, especially to the novice commuter. It takes extra time to prepare for and recover from the bicycle trip. With practice these extra activities become second nature, but repeated locking and unlocking a bicycle can be very frustrating to a new rider. The bicycle does not appear to be a good vehicle for carrying things like books, briefcases, pocketbooks, or groceries. Again with practice and the proper equipment, carrying things on a bike is no problem. But the new cyclist doesn't know this.

Prospective cyclists also are not familiar with the best routes to take to their destination. Either they take the same route as they do in a car and find themselves in a more demanding situation than they can handle, or they take a very roundabout way which takes longer than they anticipated. Thirty percent of the Barton-Aschman respondents felt that they would arrive late to work if they rode a bicycle. In reality, bicycle commuting frequently can be faster than automobile or mass transit commuting for short urban trips.

An attitude toward bicycling which is prevalent among cyclists and non-cyclists alike is that it does not always fit with a professional lifestyle. This does not refer to the social status problem discussed earlier, but to a more practical problem of personal appearance. If you bicycle five miles to work on a summer day you will arrive at the office sweaty and grimy. You can either live with this condition all day or bring a change of clothes. Both of these alternatives have their problem. No matter what the solution, a certain level of tolerance for inconvenience is required of someone who chooses to ride to work regularly.

Bicycle Safety. Perhaps as an outgrowth of many of the attitudes described above, bicycles have gotten a reputation for being a safety problem.

The national number of bicyclist fatalities for several recent years is indicated in Table II-8. These data were drawn from the National Highway Traffic Administration's Fatal Accident Reporting System (FARS).

Table II-8  
Bicyclist Fatalities

<u>Year</u>	<u>Number of Fatalities</u>
1975	1,003
1976	914
1977	922
1978	892

It is estimated that 82% of bicyclist fatalities result from car-bike collisions.<sup>12</sup>

<sup>12</sup>National Electronic Injury Surveillance System (NEISS) figures for 1975, as quoted in A Study of Bicycle/Motor Vehicle Accidents: Identification of Problem Types and Countermeasure Approaches, Volume 1, prepared by Dr. Kenneth Cross, Anacapa Sciences for N.H.T.S.A., Contract No. DOT-HS-4-00982, September 1977, p. 28

The estimates for bicyclist injuries from car-bike collisions range from the National Safety Council's figure of 40,000 disabling injuries to Dr. Ken Cross' estimate of 80,000 injury-producing bicycle-motor vehicle accidents per year.<sup>13</sup> Beyond these figures is the Consumer Product Safety Commission's estimate of 448,000 bicycle-related injuries treated at hospital emergency rooms in 1978. It should be noted that this figure does not include injuries treated at a doctor's office or at home. (A 1970 Food and Drug Administration household survey showed that only 38% of all disabling product-related injuries are treated in hospital emergency rooms.)

The bicycle fatality estimate is heavily skewed toward the 19 and under age group, with the highest concentration under 7. (See Figures II-1 and II-2.) These accidents result from behavioral problems with both bicyclists and motorists.

Both young and old cyclists have little regard for the rules of the road, perhaps as a result of the "bicycle is a toy" attitude. Even though they "know better," they run stop signs, ride without yielding, turn without signaling, and travel on the wrong side of the road. Widespread violation of traffic rules not only contributes to motorists' negative attitudes toward bicyclists, it is also a major causal factor in accidents involving young cyclists.<sup>14</sup>

Most of the accidents involving older cyclists directly or indirectly resulted from a motorist's failure to yield the right-of-way to the bicyclist. Frequently this occurred because the motorist did not see the bicyclist even though he/she looked in the cyclist's direction. Many motorists do not consider bicycles to be "real vehicles" and may underestimate a bicyclist's speed or the distance required to pass a cyclist safely.

#### Environmental Conditions

Once bicyclists have decided to ride they begin their interaction with the environment. A few environmental conditions significantly effect the

---

<sup>13</sup>Ibid, p. 27.

<sup>14</sup>Comments on car/bike accident factors are based on a review of A Study of Bicycle/Motor Vehicle Accidents: Identification of Problem Types and Countermeasure Approaches, *op. cit.*

# Number of Pedalcyclist Fatalities

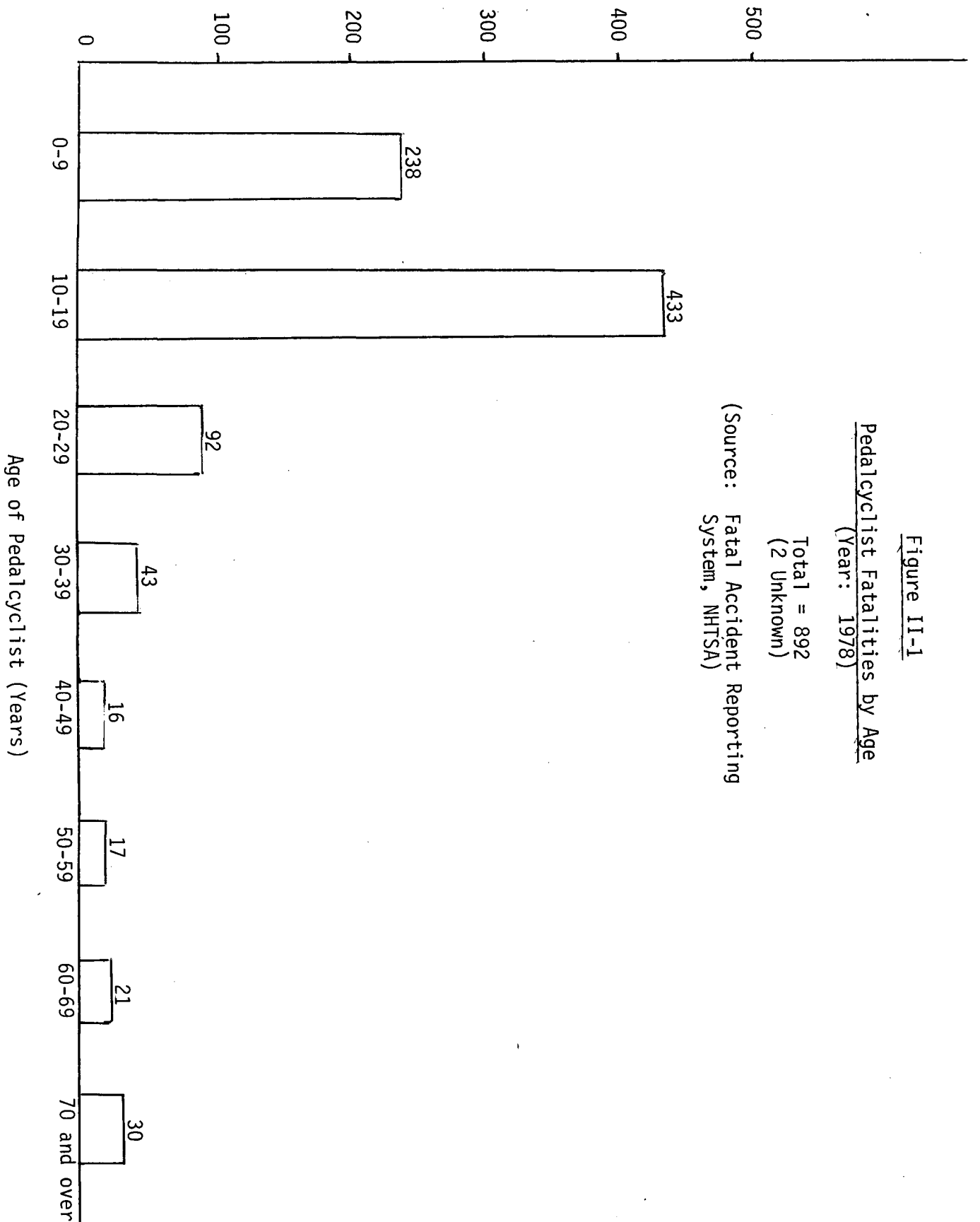


Figure II-1  
Pedalcyclist Fatalities by Age  
(Year: 1978)

Total = 892  
(2 Unknown)

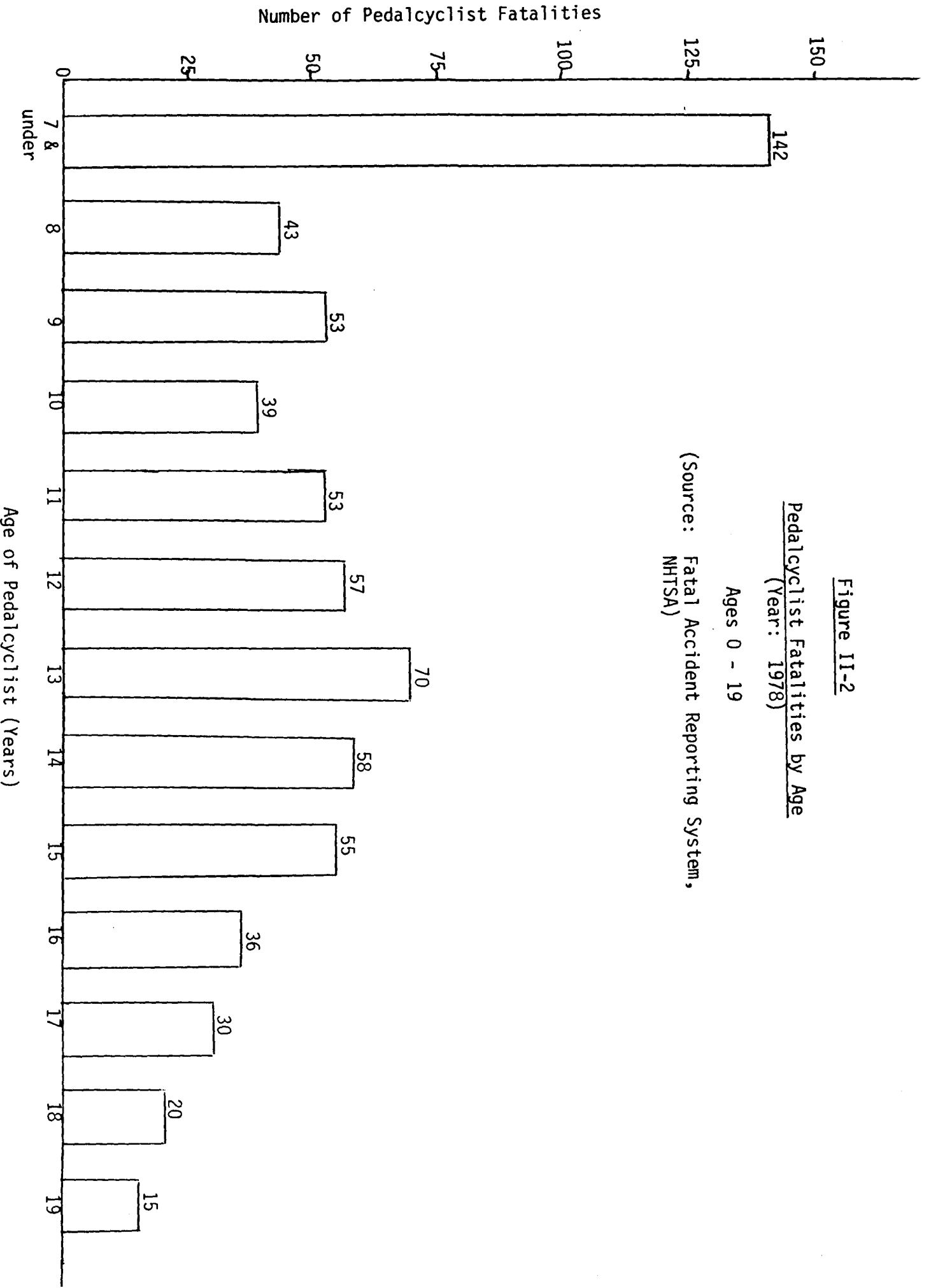
(Source: Fatal Accident Reporting System, NHTSA)

Figure II-2

Pedalcyclist Fatalities by Age  
(Year: 1978)

Ages 0 - 19

(Source: Fatal Accident Reporting System,  
NHTSA)



bicyclist but cannot be changed, while the majority of conditions are "man-made" and therefore amenable to change.

Weather and Terrain. The "unchangeable" aspects of the environment are weather and terrain. There has been a great deal of speculation on the effect of both of these on bicycle use but very little substantiation. Probably the most accurate statement that could be made is that the impact of weather and terrain is relative. Cyclists in the Pacific Northwest regularly ride in conditions that a native of Arizona would consider intolerable. The perception of "steep" is quite different for a resident of Kansas than it is for someone from San Francisco. A person's attitude toward physical exercise and his or her actual level of conditioning are also major determinants of the effect of terrain on cycling.

Weather and terrain generally make bicycling more or less comfortable for the cyclist at any particular time and place. The significance of weather, however, is probably greater than that of terrain since weather is variable and terrain is not, in any given location. A cyclist decides just once whether the terrain is "bikeable," but he or she must decide every day if the weather is, or will be, acceptable.

Since bicyclists have to prepare for possible changes in the weather (clothes, lights, etc.), just the threat of rain may be all it takes to discourage someone from riding on a particular day. Weather, particularly rain, can also affect the safety of the cyclist, turning a relatively easy trip into a nightmare because of wet man-hole covers, lane striping, accumulated leaves, and reduced braking capacity.

The effect of extremes of temperature on levels of cycling have been examined rather superficially, but no clear cut-off has been determined. Rather, the greatest deterrents to bicycling appear to be heavy rain, snow, ice, and darkness.<sup>15</sup>

Since bicyclists generally make their own personal decisions concerning weather and terrain, much more emphasis has been placed on those aspects of

---

<sup>15</sup>Personal conversation with William C. Wilkinson, Program Coordinator, U. S. Department of Transportation.

the bicycling environment that affect everyone almost equally and can be changed. This would include special bicycle facilities, the existing roadway network, and support facilities.

Special Bicycle Facilities. Numerous separate bicycle paths have been constructed throughout the United States. Positive aspects of these facilities include: (1) introducing novice cyclists to bicycling in an unpressured environment; (2) providing a pleasant recreational environment; (3) enhancing safety and convenience if well designed; (4) bolstering public awareness of bicycling; and (5) providing direction to cyclists in the absence of bicycle maps.

Negative features that have been mentioned are: (1) facilities accommodate only novice riders; (2) adequate maintenance is often lacking; (3) the quality of design and construction frequently discourage use; (4) many paths are through secluded areas, posing security problems; and inadequate lighting reduces use at night; (5) signs are inadequate in indicating route direction, hazards, and regulations; (6) separation of bicycles and motor vehicles has been emphasized, although intersections, where the majority of accidents occur, have not been eliminated; (7) most paths do not provide access to the wide range of destinations desired by cyclists; and (8) evaluation of facilities is viewed as a frill that constrains facility length, resulting in repetition of costly design errors.

Two other types of bicycle facilities--bicycle lanes and bicycle routes--have several unique features. Bicycle lanes--on-street lanes separated from auto traffic by either a painted stripe or a curb--are designed to provide cyclists with access to existing roadways, while protecting them from direct "competition" with autos. Though popular with many cyclists, several problems arise with bicycle lanes. They (1) can set up turning conflicts with auto traffic; (2) frequently disappear at bottlenecks with no warning or place for the bicyclists to go; (3) tend to collect debris, sand and broken glass when not maintained; (4) frequently must accommodate parking, thereby providing inadequate clearance for bicycles; and (5) encourage bicyclists to make left turns from the right edge of the roadway.

Bicycle routes are regular streets designated by signs as suitable for bicycle travel. Bicycle route signs, however, do not indicate where the route goes. The route may stop without notice, leaving it up to the cyclist to choose an acceptable alternative. Bicycle routes also can create a false sense of security among cyclists. It is possible, however, that with a thorough educational program for cyclists and motorists, a well-designed bicycle route system can be effective in directing bicycle travel onto less demanding routes.

A recent study by the California Department of Transportation identified the types of special bicycle facilities that should be avoided because of serious problems associated with their design and use: (1) two-way bicycle lanes that require one direction of bicycle traffic to ride against traffic; (2) sidewalk bikeways that are designed for pedestrian speeds (3 mph) and can cause bicycle conflicts with pedestrians, sidewalk furniture, and with motorists at intersections; (3) protected bike lanes that trap bicyclists and motorists in potential conflicts; (4) bike paths parallel to arterials that provide a lower level of service than the highway they were designed to replace; and (5) bikeways that do nothing for cyclists other than prevent them from using the street system.<sup>16</sup>

Even if all the problems of special bicycle facilities were eliminated, it would still be unreasonable to expect a community to build a completely separate system of bikepaths to accommodate commuter and recreational cyclists. In downtown urban areas, there simply isn't the space for a separated facility, and in rural areas, the expected level of use would not justify the expense. The existing road system is the only system which can provide access to all residential and employment areas. The best uses of special facilities are to supplement the existing roadway system by by-passing particularly hazardous situations, and to provide a "training and orientation environment" in which novice cyclists can gain sufficient experience on their bike before moving out onto the street.

---

<sup>16</sup> Planning and Design Criteria for Bikeways in California, California Department of Transportation, 1978.



Existing Roadway System. The Geelong Bike Plan, a comprehensive program to encourage bicycling in Victoria, Australia, operates on the premise that "Every street is a cycle street."<sup>17</sup> Local residential and secondary streets can be very suitable for bicycling. But problems do exist. Just as a unique climate or terrain can make any city more or less suitable for bicycling, the characteristics of the existing roadway system determine the suitability or hostility of a local transportation system to bicycling.

Wide curb lanes, paved shoulders, good sight distances, shrubbery ordinances, well maintained streets and shoulders, a comprehensive network of low traffic-volume streets, and bicycle-activated traffic signals are some of the characteristics of an "ideal" bicycling environment. Unfortunately, a more realistic description of the current situation would include a series of surface hazards, design problems, barriers or bottlenecks, and bicycling disincentives.

The more common complaints from bicyclists about the surface condition of existing roads include horizontal sewer inlet grates which trap bicycle wheels; broken or uneven pavement at the road edge; potholes; glass, gravel, and debris; railroad crossings and speed bumps, all which cause cyclists to fall; and man-hole covers, lane striping and crosswalk stripes which become extremely slippery when wet.

There are also several aspects of street and highway design which can discourage bicycle use. Obviously the existing roadway has not been designed for bicycles. Unfortunately, the requirements of the bicycle are more subtle than those of autos and therefore bicyclists are more aware of and susceptible to the little eccentricities of any particular street. An intersection that works moderately well for automobiles may be totally unsafe or awkward for bicyclists, requiring them to dismount and walk across. Narrow curb lanes either force bicyclists to occupy the center of a lane (not necessarily unsafe but usually intimidating) or convince him or her that bicycles don't belong on that particular street. Shoulders frequently disappear at bridges causing the bicyclist

---

<sup>17</sup>Geelong Bikeplan, for the Victoria Government, Victoria, Australia, November 1977.

to weave in and out of the traffic flow. The combination of heavy traffic volume, high speeds, and narrow curb lanes is a very stressful situation to the average bicyclist. If those were the conditions on the only route to an important destination, e.g., downtown or an industrial park, bicycling would likely not occur in significant numbers.

Barriers are generally more substantial obstacles to direct bicycle access. Bicyclists frequently are barred from bridges, tunnels and limited access highways. While this is usually done in the alleged interest of safety, those who make the decision to ban bicycles frequently do not take into consideration that there is no other route from A to point B. In other instances, when an alternative route does exist, it is frequently more dangerous than the route on which the ban was imposed. This general situation of banning bicycles is especially frustrating when no advance warning is given, and bicyclists are forced to backtrack several miles, or give up their trip altogether.

The presence of bicycles on interstate highways has been particularly controversial. Some bicyclists argue that the interstate highway offers a smooth wide shoulder with a minimal number of intersections (on/off ramps), good sight distance, and adequate separation from automobile and truck traffic. The alternate state routes frequently have the same posted limit as the interstate system but with poor or non-existent shoulders, inadequate sight distances, frequent intersections, and insufficient lighting. Currently, Washington, Wisconsin, California, and Colorado allow bicycles on selected portions of the interstate, when there is no safe parallel route. North Dakota specifically allows bicycles on all portions of the interstate system in that state. Bicycles are generally allowed on the interstate, that is no mention is made in the statutes and no action is taken against them, in Idaho, Oklahoma, Texas, Oregon, Minnesota, Montana, South Dakota, and Wyoming. All of the remaining states specifically prohibit bicycles from the interstate system. It is interesting to note the split between the Eastern and Western half of the country in the resolution of this question.

A problem area for bicyclists separate from those discussed above is the wide range of disincentives that exist in the transportation system: the host of little things that make bicycling just a little too inconvenient

for the less than committed cyclists. Among the list compiled by bicyclists commenting to DOT are: the proliferation of stop signs on residential streets where yield signs would be adequate; traffic signal activators that do not respond to the presence of bicycles; and pedestrian "walk buttons" which are out of reach of a cyclist. Another type of disincentive would include high quantities of air pollution, and heavy traffic volume during rush hour. The heavy traffic volumes present on some streets during rush hour create a stressful atmosphere for some cyclists that is sufficient to discourage them from regularly commuting to work.

Multi-modal access is a problem for many cyclists. Bikes are forbidden on most trains, subways or buses. The problem is compounded by the fact that there are generally inadequate bicycle parking facilities at stations and terminals. These two conditions eliminate the possibility of cyclists bicycling part of the way to work and taking mass transit for the remainder of the trip, or taking their bicycles on mass transit to work and bicycling home, an option that would effectively deal with the problem of arriving at work hot and sweaty.

With the widespread increase in bicycling has come an expanded understanding of the problems cyclists face. If the actual barriers and hazards have not been removed in every city, there has at least been an acceptance by many city officials of the need and responsibility to remove them. Spot improvement schedules are being included in many communities' bicycle plans. Specific barriers are being breached through such programs as special bike shuttle-buses across the San Francisco Bay Bridge and the Verranzano Narrows Bridge in New York and a special bicycle bridge in Eugene, Oregon. Seattle is installing rubberized railroad crossings to eliminate the cyclist's risk of falling. In San Diego and Santa Barbara, California bicycles are carried on the backs of buses along selected routes.

These are just examples of the types of things that are being done in various communities to improve the roadway environment. As programs such as these are evaluated and documented, it is likely that they will be repeated by other communities.

Support Facilities. Most, if not all, of the attention focused on bicycling in the past several years has been directed to bicycle riding. Obviously, it is the most visible aspect of the activity and has the most

interaction with other highway users. What cyclists do when they get to where they are going is viewed to be a personal problem rather than a community problem.

Unfortunately, those "personal" problems which bicyclists encounter frequently are sufficient to discourage regular use of the bicycle as a transportation mode. Destinalional problems fall into two major categories: (1) parking/storage and (2) showers.

Fear of theft is a significant disincentive to bicycle transportation. 48.2% of those surveyed by Barton-Aschman indicated they were afraid that their bikes would be stolen at work. A recent Baltimore, Maryland survey of cyclists discovered that 25% of those polled had had their bicycles stolen.<sup>18</sup> Twenty percent of those who had been theft victims reported that they gave up bicycling as a result of the experience.

There are three bicycle thefts for every automobile theft in the United States.<sup>19</sup> The Bicycling in Pennsylvania bicycle study reported that the recovery rate for stolen bicycles is only 18% as compared with 75% for stolen automobiles. Bicycle accessories, such as lights, pumps, and carriers are also subject to theft and vandalism.

Unfortunately, the bicycle is extremely vulnerable to theft. It is easily portable, and typical bicycle locks and chains can be disabled in seconds. Conventional "bike racks" do little to secure a bicycle. They match neither the refined technology of the bicycle itself, nor the ingenuity of the bicycle thief. Several cyclists attempt to bring their bikes into the building where they work, but Fire Codes, property management regulations, etc., usually do not allow this.

There are two major user needs for bicycle parking: commuter long-term storage facilities and convenience short-term parking. The commuter facilities must provide high security by locking the frame, both wheels, and accessories while providing protection against vandalism and weather. Convenience facilities should provide a means of securing the frame and both

---

<sup>18</sup>Bicycle Parking, A Design Manual, Baltimore County Bikeways Task Force.

<sup>19</sup>Barton-Aschman Associates, Bicycling in Pennsylvania, for the Commonwealth of Pennsylvania, 1976.

wheels with the user providing the lock. The convenience facility especially should be located near the building entrance (school, shopping center, library, etc.) to encourage use.

There have been recent developments in bicycle parking technology (bike lockers, high strength user-supplied locks and improved racks) which can provide sufficient protection to reduce the fear of bicycle theft. Although several communities have instituted local ordinances requiring the provision of bicycle parking in all new public construction, these new improvements and approaches have not been widely recognized or implemented.

Showers and lockers at employment centers are cited by many cyclists as absolute necessities for regular commuting. These facilities, however, are rarely available to cyclists. Apparently, people do commute by bicycle in the absence of such amenities, but 50% of those surveyed by Barton-Aschman indicated that arriving at work sweaty from cycling is a major problem. The San Diego bicycling commuting study reported that the greatest concern for shower and locker facilities is expressed by clerical, management, and technical/professional workers. The comments made in the San Diego study indicated that more formal dress requirements and the attention paid to personal appearance, especially among clerical personnel, were responsible for this high level of concern.

A few large companies and Federal agencies (E.P.A. for example) have shower facilities available to cyclists. It is generally acknowledged, however, that this involves a large capital expenditure on the part of the employer.

### Institutional Involvement

For our purposes, an institution is defined as any agency, organization, legislative body, or association in the public or private sector which is responsible for programs, policies, regulations, or products which affect bicycle transportation. Our treatment of the institutional response will consist of a discussion of the three main institutional systems which directly affect bicycling (legal, education and transportation), and a review of the general type of institutional response which we have called administration. This refers to the overall posture the different levels of

government and private sector organizations take towards bicycling.

We have found that a discussion of existing institutional conditions easily develops into a description of what "should be," but does not currently exist. Rather than force this presentation into a catalogue of "does not's" we have allowed ourselves to slip back and forth between the real world and a modified utopia.

Legal System. The legitimacy of the bicycle as a transportation mode begins with the legal status of the vehicle. A weakness or a failure in the law itself, in law enforcement, or in law adjudication may serve to reduce the potential of bicycle transportation. Two types of regulations directly affect bicycle transportation: (1) administrative laws, policies, or orders; and (2) vehicle codes.

In the first category, administrative law, bicycle planners and coordinators frequently cite a problem concerning legislative restrictions on the use of highway money for bicycle-related projects. In several states, highway funds by law cannot be used for non-motorized transportation, effectively limiting a commitment by a state agency to bicycle transportation. A few states, however, such as California and Oregon, have taken positive steps to provide support and encouragement for bicycling projects.

A second administrative policy problem is the assignment of responsibility for bicycle design regulation. The issue is whether it should be regulated by the Consumer Product Safety Commission (CPSC) where it currently rests or be shifted to the National Highway Traffic Safety Administration (NHTSA) which regulates all other highway vehicles. CPSC safety equipment requirements apply only at the point of sale, leaving the operator free to make modifications which might create a safety problem. If the bicycle were to be regulated by NHTSA, it is possible that design standards could be more closely linked to the results of DOT accident research and to other bicycle safety programs, and integrated with the larger body of transportation vehicle standards developed by experts in highway safety.

The larger body of laws dealing with bicycles is housed in state vehicle codes and municipal traffic ordinances, which define the bicycle, describe the rights and responsibilities of the cyclist, specify safety equipment requirements, and in some cases, establish procedures for vehicle registration.

In the Uniform Vehicle Code (UVC), a collection of model laws established by the National Committee on Uniform Traffic Laws and Ordinances (NCUTLO), bicycles are included in the definition of "vehicle." Thus, the legal status of the bicycle as a transportation mode is clearly established. Twelve states (as of 1978) have similarly defined the bicycle as a vehicle.<sup>20</sup> The remaining states all have provisions that the bicyclist is subject to the same rules and has the same rights as the operator of a vehicle. In theory, this achieves the same purpose in terms of regulating operation, but it does not always provide the same protection of the cyclists' rights as would the definition of "vehicle." In some cases, charges against a motor vehicle operator have been dropped because the incident in question involved a "vehicle" and a "bicycle" rather than two "vehicles."

There are two significant departures for bicycles from the rules of the road for other vehicles. First, most state laws specify that the bicycle must stay as close to the right edge of the road as is possible, safe, and reasonable. These terms are somewhat vague and may be interpreted differently by bicyclists, police officers, and the courts. Also, hazards on the right edge of the road may jeopardize the cyclist's safety and mobility. Therefore, the NCUTLO recently modified this provision. Under the new provision, the cyclist would be required to keep to the right only when moving slower than traffic. Further, slow-moving bicyclists would be allowed to move out from the curb to make left turns, to avoid parked cars, debris, or glass, or if the lane was too narrow.

A second restrictive provision is the mandatory bike path usage law, which stipulates that the bicyclist must use a path if it is adjacent to the roadway. Many cyclists claim that such a law is unnecessary; if the path is good it will be used. However, many bike paths are more dangerous than the adjacent roadways because of the numerous design, construction, and maintenance problems, and the potential for conflicts with pedestrians, roller skaters, and child bicyclists. The NCUTLO, however, recently rejected a proposal to delete this mandatory bike path usage provision from the UVC.

State vehicle codes and municipal traffic ordinances also require specific equipment on bicycles for braking, lighting, and audible warnings.

---

<sup>20</sup>"The Cyclist and the Code," Bicycle Forum, No. 4 (Fall 1979), p. 15.

The UVC braking requirements specify that the bicycle must be stopped within 25 feet from a speed of 10 mph on clear, dry, level pavement. A headlight is required on bicycles from one-half hour after sunset to one-half hour before dawn, or any other time conditions require it. This light must emit a white light visible for 500 feet to the front. At all times, an approved red reflector, visible from 600 feet to the rear, or a lighted lamp visible from both sides for 500 feet, is to be used when the bicycle is ridden between sunset and dawn. Bicyclists must give an audible signal to warn pedestrians.

Bicycle registration has been regarded variously as an essential component of a theft prevention program and as a useless waste of taxpayers' money. Registration programs, whether voluntary or mandatory, operate in one of four ways: (1) the local police or fire department engraves an owner identification number on the bicycle frame; (2) the community or county provides a decal or a license plate and maintains a file of all registered bicycles; (3) the state provides forms and tags to the community, which has the option to establish its own program to collect revenue (California); and (4) the state operates a bicycle registration program through the department of motor vehicles, and funds go to state bicycle programs (Minnesota). Only two states, California and Minnesota, have enacted legislation which has led to active statewide bicycle registration.

North Carolina recently surveyed cities in all 50 states to identify current practices in bicycle registration.<sup>21</sup> Sixty percent of the cities sampled have mandatory registration programs but enforcement varies widely. Registration fees range from no cost to \$3.50 for three years. The average cost is less than \$1 per year. Sixty-four percent of the programs were run by police departments. Success of the program appears to depend on community support and the level of enforcement.

An area that is frequently linked with registration is operator licensing. In essence, this type of program would establish age and/or competency requirements for the operation of a bicycle on city streets. Ordinances which move in this direction without calling it licensing have been established in one or two communities throughout the country. There

---

<sup>21</sup>Michael D. Connelly and Elizabeth R. Lofton, North Carolina Bicycle Registration Study, Research Triangle Institute, November 1978.



does not appear to be any effort at all to enforce these ordinances, however.<sup>22</sup>

The subject of licensing as a means of reducing accidents in the younger age groups has been raised again and again at safety conferences. The concensus has been that licensing is essential to prevent young children who cannot operate a bicycle safely from riding in traffic, but that it would not be accepted by the community. Operator licensing should be tried on a pilot basis to see if the idea is feasible.

The enforcement of bicycling laws suffers from many problems. There is not a lot of community support for the concept, police administrators cannot give it a high priority program, and enforcement officers are generally reluctant, even embarrassed, to issue citations to bicyclists, child or adult. They do not view bicycle enforcement as "real" police work. Those police who are in bicycling programs frequently play an educational role through Officer Friendly programs or bicycle rodeos rather than an enforcement role.

There are several examples, however, of successful enforcement programs at the state and local level. Some of the essential components of these programs are:

- Written guidelines and policies instructing officers how to handle various violations. Wisconsin has published a set of policies and procedures for bicycle enforcement.
- Strong community support for the program and good media coverage emphasizing the benefits of the program. This is most likely to exist in smaller towns.
- Clear direction for enforcement personnel in terms of hours to be committed to bicycle patrol or number of citations to be issued.
- A public education campaign and a warning program to precede the issuance of citations.
- In-service bicycling training for police officers and police academy courses on bicycling for cadets. These programs should provide police with a thorough explanation of the rules of the road that affect bicyclists and require the officers ride bicycles in order to understand the operational problems cyclists encounter.

---

<sup>22</sup>Discussion between Bicycle Forum magazine and Ed Kearney, Executive Director, NCUTLO.

- Selective enforcement campaigns which allow officers to concentrate on the more hazardous violations and ignore the "nuisance" violations which create a negative public image for the enforcement campaign.
- Sufficient funding to allow for an ongoing program with sufficient staffing rather than an enforcement "crackdown" which has little long-lasting effect.<sup>23</sup>

Several police departments have gotten around the staffing problem through the hiring of CETA personnel to serve as bicycle patrols to supplement the regular enforcement staff. These patrols create a positive image for safe bicycling in the community, take some of the financial and personnel burden off the regular police force, and expand the police presence in the community thereby reducing a wide variety of traffic violations.

Another area that falls under police jurisdiction is the reporting and investigation of bicycle accidents. The police accident-report form is the only source of information on the nature and cause of car-bike accidents. Since many police officers are not aware of the operating characteristics of bicycles, they may omit important accident causation information, and tend to assume that the bicyclist was at fault. Bicycle accidents frequently are lumped with pedestrian accidents so that it is difficult to generate accurate information on the number of accidents and fatalities per year. Information contained on the accident report form should be on the basis for problem identification leading to effective program development (i.e., education countermeasures, selective enforcement, and facilities construction). A high priority, therefore, should be placed on improving the accuracy and quality of bicycle accident information.

Two aspects of adjudication are significant for bicycle transportation. First, obviously, is the judicial treatment rendered to bicyclists who are cited for violating traffic law. Enforcement personnel claim that the courts' disinterest is indicative of the low level of community support for bicycling, and of the pervasive attitude that bicycling is a child's activity, and therefore, a waste of courtroom time. Many judges claim that child

---

<sup>23</sup>These observations were drawn from the unpublished draft report, "Community Bicycle Programs," prepared by the Bicycle Federation for the U. S. Department of Transportation, Office of the Secretary, 1979.

bicyclists do not belong in traffic court, nor do they belong in juvenile court, which leaves NO logical place for them to go. Judges also do not know what to do with adult violators. The question has been raised, but not answered, as to whether record of a bicycle violation should affect the status of one's motor vehicle license. Since a license is not required, many cyclists claim that the courts and the police have no right to even look at the driver's license.

Some progress has been made through the use of peer courts and innovative remedial actions. Peer courts for youthful bicyclists have been established with high school students serving as judges. This eliminates the burden on traffic courts and has the added advantage of educating all those involved, judge and defendant alike. Violator schools and community service programs have been used as a means of "punishing" the offender while providing him or her with important bicycle safety information or with a broadening experience. Parents of young violators are also involved in the entire adjudication process to create an awareness of the seriousness of bicycle safety violations. Bicycles may be impounded for serious or repeat offenses. Again, the support of the community is essential for this type of program.

The second critical aspect of adjudication is the treatment of motorists who violate cyclists' rights, or more importantly, are responsible for a car/bike collision. There are numerous cases reported in bicycling magazines of a motorist being acquitted of any responsibility for a bicyclist fatality. It is difficult to judge the merits of the bicyclists' claim that justice was not served, but it is important to recognize the frequency of the motorist's claim, "I didn't see him" as an excuse for a fatal accident.

Judges, especially in fatal cases where there are no witnesses, should be extremely reluctant to accept the plea that the bicyclist was invisible. The color of the bicyclist's clothing, his or her position on the roadway, and the condition of reflectors and lights should all be examined before such a defense is accepted. Bicyclists should recognize that unless they ride responsibly, obeying all the rules and providing for their own conspicuity, they will be treated as unpredictable children, thereby allowing the motorist to claim there was nothing he/she could do to avoid the accident.

Educational System. It is difficult to speak of the U.S. bicycling educational "system" because of the wide variety of organizations, individuals, and programs that are in some way involved in bicycling education. While education is clearly an institutional response, it would be incorrect to view it as the domain of a single institution. The public school structure, colleges and universities, police departments, agricultural extension programs, volunteer safety organizations, bicycling clubs, state and local motor vehicle administrations, summer camps and recreational departments are just a few of the "institutions" that are currently involved in some form of bicycling education.

Bicycling education, as defined here, refers to the conveyance of information or the development of skills related to bicycling. Adult cyclists need special training in bicycle handling and traffic competence in order to deal with commuting traffic situations. Motorists and professionals (those whose work involves bicycle programs: police officers, traffic engineers, educators) need information and training to develop skills and to improve their interactions with bicyclists. Unfortunately, such needs are overlooked by the current educational system. Figure II-3 illustrates the range of audiences and delivery systems that should be included in a comprehensive education program.<sup>24</sup>

As the chart clearly shows, the bulk of existing programs are safety oriented campaigns directed at child cyclists. Further, there is very little effort to improve actual operating performance of child cyclists through on-the-bicycle skills development programs.

The needs of adult cyclists are all but completely ignored. Bicycle clubs sometimes offer instruction programs, but these are usually geared to the cyclist with advanced skills interested in long-distance touring or racing. Some adult courses, while covering all the basics, intimidate new riders because of instructor's emphasis on heavy traffic riding styles. Bicycling magazines frequently focus on the highly technical aspects of cycling such as "gear ratios" and "electrolyte replacement" and ignore the more basic concerns of novice riders. Nowhere is there an easy-to-read

---

<sup>24</sup>This chart is reproduced from the chapter on education in the Draft Catalog of Programs prepared by the Bicycle Federation for the U. S. Department of Transportation Community Bicycle Programs Study.

FIGURE II-3

BICYCLING EDUCATION  
AUDIENCES AND DELIVERY SYSTEMS

<u>BICYCLISTS</u>		<u>NON-SCHOOL BASED</u>		<u>MOTORISTS</u>		<u>PROFESSIONAL</u>
<u>SCHOOL</u>	<u>BASED</u>	<u>Child</u>	<u>Adult</u>	<u>Driver's Education</u>	<u>Journals</u>	
<u>Elementary</u>	<u>Secondary</u>	<u>College</u>	<u>Child</u>	<u>Adult</u>	<u>Adult</u>	
<u>Classroom</u>	<u>On-Bike</u>					
<ul style="list-style-type: none"> <li>● Curriculum Guides</li> <li>● Officer Friendly</li> <li>● Movies/AV</li> <li>● Pamphlets</li> </ul>	<ul style="list-style-type: none"> <li>● Safety Town</li> <li><i>Skills Development</i></li> <li>● Peer Instruct.</li> </ul>	<ul style="list-style-type: none"> <li><i>Physical Education</i></li> </ul>	<ul style="list-style-type: none"> <li>● Rodeos</li> <li>● Pedal Camps</li> <li>● Violator Schools</li> <li>● Parents</li> <li>● Scouts</li> <li>● 4-H</li> <li>● Public Information</li> <li><i>Skill Development Prog.</i></li> </ul>	<ul style="list-style-type: none"> <li>● Violator School</li> <li><i>Recreation Department</i></li> <li><i>"Effective Cycling"</i></li> <li><i>Bike Clubs</i></li> <li><i>Employer Programs</i></li> <li><i>Public Information</i></li> <li><i>Skill Development Prog.</i></li> </ul>	<ul style="list-style-type: none"> <li>● Driver's Education</li> <li>● Driver's Licensing Exam</li> <li>● Public Information</li> </ul>	<ul style="list-style-type: none"> <li><i>Training Seminars</i></li> <li><i>In-Service Training</i></li> <li><i>Conferences</i></li> <li><i>Certification</i></li> </ul>

KEY: Items in *Italics* are not in widespread use in 1980.

Items preceded by a ● are primarily safety programs

digest of the basics of bicycling. Fundamental, non-threatening, adult bicycling education programs which cover bicycle safety, operating skills and maintenance are rare indeed.

The root cause for this problem is the still pervasive attitude that (1) bicycling is for kids and (2) every kid already knows "how to ride a bike." Schools do not consider it their responsibility to teach children how to ride a bicycle, but rather, to provide the children with the safety information needed to survive this "dangerous pasttime." If they do survive, it is assumed they will get driver's licenses, so bicycling need never be mentioned again.

If an adult does rediscover the bicycle, it is generally accepted that "once you learn how to ride a bicycle you never forget." Adults may indeed never forget how to balance and steer in a straight line, but chances are they never learned how to operate a 10-speed in downtown rush hour traffic. The particular needs of adult cyclists are only beginning to be recognized by educational "institutions." It appears that it could be sometime before novice adult bicycle programs are generally available.

Motorist education programs, as Figure II-3 illustrated, could consist of public information campaigns, driver education, and licensing activities. There are a few states (e.g., Wisconsin and California) which are beginning to include information about bicyclists in their driver's manual and questions relating to bicycle/motor vehicle interaction on the driver license examination. This type of attention can impress the prospective motorist with the legitimacy of bicycles as part of the traffic mix. The driver's education curriculum and licensing examination, however, are already overcrowded and could only accommodate a few summary issues on bicycling.

The public information approach offers the possibility of reaching a much larger audience with more pertinent information. Television and radio "spots" offer the advantage of alerting a large audience to the presence of bicyclists on the roadway. Printed messages are a necessary follow-up to provide the detailed information a motorist needs to share the road effectively with cyclists. Wisconsin, Michigan, and North Carolina have all produced flyers of this sort.

Professional training related to bicycle transportation is practically non-existent. There has been some recognition of the need for specific information on bicycle facility design, but many professionals are only beginning to recognize the fact that there is anything to learn about bicycles.

### Transportation System

Many of the disincentives to increased bicycling are the result of the low level of integration of bicycling into the U. S. transportation system. Three root causes account for this situation: (1) lack of awareness and understanding of bicycling concerns among transportation professionals; (2) fragmentation of transportation planning and management; and (3) low level of policy and funding commitment to support bicycling. Combined, these causes produce a situation common in Federal, state, and local transportation agencies: bicycling is simply overlooked.

Lack of Awareness. A recent review of 21 college transportation textbooks, most of which are geared toward civil engineering, revealed the low level of consideration given bicycling. Fifteen of the textbooks contained no mention of modern bicycling transportation. Of the six remaining texts, five gave brief attention to the negative aspects of bicycling that precluded it from being a "real" transportation mode.<sup>25</sup> Consequently, the bicycle often is not considered as part of a planner's or engineer's professional responsibility. There are, however, two programs now available to provide practicing planners and engineers the information, skills, and tools they need to develop and design bicycle transportation facilities. The first is a four and one-half day course, "Pedestrian and Bicycle Considerations in Urban Areas," created by Northwestern University's Traffic Institute for the Federal Highway Administration. The second is "Cycling Transportation Engineering," offered by John Forester, A California engineer and bicyclist. The

---

<sup>25</sup>Robert Alexander, "Bicycling Technology in the Transportation Curriculum," a paper presented at the Eighth National Seminar on the Planning, Design, and Implementation of Bicycle, Pedestrian and Moped Facilities, San Diego, California, July 3-6, 1979.

Bicycle Forum magazine is another new mechanism for educating transportation professionals through articles on the latest developments in the state-of-the art.<sup>26</sup>

A related problem is the lack of detailed bicycle information in recent literature on transportation planning. A random sampling of research studies, policy analyses, and governmental reports dealing with transportation planning, air quality, and energy conservation found that eight of ten made no mention of bicycle transportation where it logically should have been included.<sup>27</sup> Bicycle strategies, however, are being mentioned with increasing frequency in transportation planning reports, particularly as a

---

<sup>26</sup>Bicycle Forum magazine, 317 Beverly, Missoula, Montana, John Williams (Ed.), Dan Burden (Publisher).

<sup>27</sup> The following is a listing of some of the titles which logically should include bicycles, but in which no mention of bicycle transportation is made:

- Characteristics of Urban Transportation Demand: A Handbook for Transportation Planners--prepared by Wilbur Smith and Associates for the Urban Mass Transit Administration, January 1979.
- Characteristics of Urban Transportation Systems: A Handbook for Transportation Planners--prepared by DeLeuw Cather and Company for the U. S. Department of Transportation, 1975.
- Evaluating Options in Statewide Transportation Planning/Programming, Transportation Research Board, 1979.
- Energy Considerations in Transportation Planning, Federal Highway Administration, 1979.
- Energy Considerations in Transportation, Office of the Secretary of Transportation, 1979.
- Center City Environment and Transportation: Local Government Solutions, prepared by Public Technology, Inc. for the U. S. Department of Transportation, 1977.
- The Economic Cost of Commuting, The Highway Users Federation, 1975.
- A Policy on Design of Urban Highways and Arterial Streets, American Association of State Highway Officials, 1973.



low-cost means to improve air quality and save energy. But such references are rarely substantial and frequently are based on erroneous assumptions about the significance of bicycle transportation. Of course, exceptions to this do exist.<sup>28</sup>

The second major problem deals with transportation planning and management. Historically, transportation decision-making in the U.S. has been by individual agencies responsible for a single mode. Where modes logically interface solutions to technical problems have been worked out on a case-by-case basis. The increasing complexity of urban concerns, particularly transportation, has necessitated a shift from these traditional approaches towards more integrated planning and problem solving. The existing conditions of fragmented jurisdictions and dispersed implementation responsibility at the regional and local levels, however, make integrated planning very desirable but extremely difficult to achieve.

The significance of the above for bicycle transportation lies in the fact that as agencies and organizations struggle to coordinate their activities, bicycle considerations, which are a low priority area at best in the individual agencies, get totally overlooked in the larger picture of transit and highway interface.

In 1975, FHWA and UMTA made significant progress in this area through the issuance of guidelines which established a regulatory base for integrated planning for highway and mass transit.<sup>29</sup> This action required the establishment of a Metropolitan Planning Organization (MPO) in each urbanized area in the country.

Each MPO is responsible for developing:

1. A Unified Planning Work Program for all proposed urban transportation planning proposed for the next one to two years.

---

<sup>28</sup>Two good ones are: Joint Strategies for Urban Transportation, Air Quality and Energy Conservation (InterPlan Corporation for EPA and DOT, 1975), and Institutional Framework for Integrated Transportation Planning (Public Technology, Inc. for DOT, 1978).

<sup>29</sup>"Transportation Improvement Program," Federal Register, Volume 40, No. 181, September 17, 1975, pp. 42976-42984.

2. The Transportation Plan which contains a long-range multi-modal element consistent with the regional land use plan and social goals, and the Transportation System Management Element (TSM) which provides for short-range transportation needs and must consider pedestrians and bicycles.
3. The Transportation Improvement Program (TIP), a staged multi-year program of transportation improvements. This is essentially an implementation schedule. It does not have to include bicycles, but currently most incidental bikeways have been implemented via TIP.<sup>30</sup>

In addition, UMTA requires MPO's that are considering large-scale mass transit programs to conduct an analysis identifying alternatives, including short-range TSM improvements. As an example, Denver's proposal for a subway system was rejected by UMTA for several reasons, including the fact that the city should be relying more on bicycles, buses, and other TSM improvements.

Ideally, this system should provide for the integration of the bicycle into the overall transportation planning process. However, the MPO's do not usually give the level of consideration to bicycles that is implied in the TSM guidelines. It is too easy to reject bicycling strategies on the grounds that there are no reliable data on levels of use.

There are several MPO's which do give serious consideration to bicycle transportation. San Diego's Comprehensive Planning Organization, for example, has done an excellent job in planning for the bicycle. There still can be problems, however, even if the bicycle is included in the MPO's planning program. MPO's lack the statutory authority to require state and local agencies to implement TSM or TIP programs. Several local jurisdictions question the appropriateness of MPO's establishing guidelines for local programs since the MPO's are not directly accountable to the citizens. Furthermore, since many TSM strategies such as reduction of auto traffic are politically unpopular, local officials are frequently unwilling to support MPO recommendations.

---

<sup>30</sup>Institutional Framework for Integrated Transportation Planning, a report of the Transportation Task Force of the Urban Consortium for Technology Initiatives, Washington, D. C., October 1978.

DOT and the Environmental Protection Administration have also instituted integrated planning processes with the issuance of guidelines stressing the necessity of including air quality considerations in DOT's mandated planning process, and including transportation control measures to improve air quality in the State Implementation Plan (required by EPA). The 1977 amendments to the Clean Air Act specifically mentions 18 transportation measures to be addressed in a region's Transportation Control Plan. Three of the 18 relate directly to bicycles. EPA has just completed a Bicycle Information Document to help air quality planners, local officials, and citizens develop bicycle strategies to divert travel from autos to bicycles.<sup>31</sup>

There are also problems at the municipal level with integrating bicycles into the transportation plan. Responsibility for bicycle programs is frequently shared among the Planning, Parks and Recreation, and Transportation or Public Works Departments. Ideally, all three departments should work together on a bicycle program plan and implementation schedule, and then individually insure that their respective areas of responsibility are integrated into their agency's short- and long-range plan. Each agency should also insure that bicycles are considered in conjunction with other program activities. For example, a street paving project should provide adequate detours for bicycles as well as for motor vehicles. Bicycle transportation, however, has not achieved this level of coordination and integration in most communities.

Paradoxically, with the increased emphasis on integrated planning, bicycle transportation is in even greater danger of getting overlooked because of the low priority it has been accorded by many transportation agencies. Agencies could be placed in one of three levels of commitment to bicycle transportation. The lowest level consists of those agencies that never even consider bicycle program ideas. This is the institutional equivalent of people who do not ride bicycles--not because they choose not to--but because it has never occurred to them as an option.

The second level of the problem consists of those organizations which consider bicycle programs, but dismiss them out of hand because bicycling is not considered a viable mode of transportation. One Mid-

---

<sup>31</sup>Mayo, M., Bicycling and Air Quality Information Document, for Environmental Protection Administration, EPA-400/2-79-001, September 1979.

western city responded to the DOT Federal Register notice for this study with the comment that bicycles are not used for transportation by any segment of the working population. They also commented that bicycling was prohibited on all state and Federal highways and in the main business district. They pointed out that bicycles were used extensively for recreation by family members. The possibility that the heavy restrictions on bicycle use could be responsible for the low level of commuting does not seem to occur to them. Rather, the low level of commuting appears to justify the restrictions imposed. Similarly, many communities point to an under-utilized bike facility as the justification for freezing bicycles out of long-range plans. Consideration is not given to the fact that the facility is unsafe or inconvenient to use. At this level of commitment agencies are just looking for excuses not to do anything.

The third level is for those agencies which are interested but constrained by inadequate funds. Under existing funding procedures, bicycles must compete with other transportation needs for Federal funds. Section 217 of the Federal Aid Highway Act of 1976 allowed the use of Federal funds for bikeways but the states must decide whether to use this money to build bikeways or for some other highway improvement. As a result, only \$14.2 million of the \$170 million theoretically available since 1976 has been spent for bicycle facilities.

Section 141 of the Surface Transportation Act of 1978 provides for a categorical grant directly to state or local governments for the construction of bicycle facilities and the development of non-construction programs to enhance bicycling. Many local communities have commented that adequate financing of this program is essential for expanded bicycle programs, since it allows local administrators to consider what is needed for bicycling rather than having to seek approval from a state transportation agency. It appears that local interest in bicycle program development is considerably higher than that of state governments.<sup>32</sup> The Department

---

<sup>32</sup>John B. Corgel and Charles F. Floyd, "Toward a New Direction in Bicycle Transportation Policy," Traffic Quarterly, Volume 33, No. 2, April 1979, pp. 297-310. This article gives an excellent overview of the funding picture for bicycle programs. It points up particularly the inadequacy of Federal and state funding programs in meeting local demands for bicycle projects.

of Transportation did not seek an appropriation for the Section 141 program. The Congress, however, did appropriate \$4 million for Section 141 in FY80.

Administration. For our purposes, "administration" refers to the official position that any agency or private organization takes toward bicycling. Public institutions at the Federal, state and local levels and private organizations such as industry, the media, and non-profit groups establish administrative positions toward bicycling as reflected in their funding programs and policies.

Although bicyclists have complained that the President has not spoken out on behalf of bicycling, he mentioned bicycles in his second message on the environment.<sup>33</sup> The President also has directed the Secretary of Transportation to promote energy conservation by encouraging the application of funds to bicycle transportation.<sup>34</sup>

The Congress has initiated much of the program attention focused on the bicycle. The Highway Safety Act of 1973 directed the DOT to consider bicyclist safety and to conduct a year-long study of bicycle safety program development and implementation. In 1973 Congress passed the Federal Aid Highway Act (PL-93-87), Section 217 of which authorized \$40 million annually (with no more than \$2 million available per state) for the construction of bicycle and pedestrian facilities. The 1976 Federal Aid Highway Act raised this figure to \$45 million annually (\$2.5 million per state).

The Surface Transportation Act of 1978, Section 141, required the Secretary of Transportation to establish, by regulation, design and construction standards for bikeway projects and authorized the Secretary to make grants (up to \$20 million each year for four years) to state and local governments solely for the construction of bicycle facilities and for non-construction programs to enhance bicycle use and safety. This law also prohibits the approval of any projects that reduce access for bicycles or other forms of non-motorized transportation along a major bicycle route without providing reasonable alternatives.

---

<sup>33</sup>Transportation Energy Initiative, U. S. Department of Transportation News, DOT 95-79, August 22, 1979.

<sup>34</sup>Ibid.

Congress currently is considering legislation associated with bicycle parking. Senate Bill 460 and House Bill 2118 would require secure bicycle parking at all Federal buildings.

The principal funding programs for bicycling are administered by the DOT through the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA). NHTSA administers the Section 402 Highway Safety Program, which provides funds to state highway safety offices for bicycle accident studies, bicycle enforcement programs, public information programs, bicycle safety education programs, and the establishment of bicycle coordinator positions at the state and local levels. The bulk of the 402 funds expended on bicycling have been for safety education in elementary schools.

The other agencies with funding programs for which bicycle projects are eligible are:<sup>35</sup>

- Interior (Heritage Conservation & Recreation Service)
  - Land and Water Conservation Fund Program
  - Historic Preservation Funds
- Housing and Urban Development
  - Community Development and Block Grant Program
- Environmental Protection Administration
  - Wastewater Treatment Grant Project
  - Section 175 of the Clean Air Act Amendment of 1977
- National Endowment for the Arts
  - Liveable Cities Program
  - Design, Communications, and Research Programs
- Health, Education and Welfare
  - Safety Education Program
- Commerce (Economic Development Administration)
  - Public Works Grant Program

---

<sup>35</sup>Leslie Baldwin, "Federal Funds for Bicycles," Bicycle Forum, No. 2, Fall 1978.

- Energy
  - Appropriate Technology Small Grants Program
- Labor
  - Comprehensive Employment and Training Act (CETA)
- Agriculture
  - Watershed Protection Program
  - Resource Conservation and Development Program

Yet another area for consideration is Federal agency support of employee bicycling. Currently business trips made by bicycle are not eligible for reimbursement, although a recent DOT recommendation to Congress indicated that this policy should be changed. Some Federal buildings currently provide parking facilities and showers for bicycle commuters. The General Services Administration has recently announced a bicycle parking policy designed to encourage bicycle use by providing improved bicycle parking.

At the state level, resources are committed to the development of large-scale programs, such as bicycle education curricula, to the establishment of guidelines for the implementation of local projects and to implement specific highway improvements. States serve as conduits for Federal funds to local governments. To facilitate program development, several states have established a position of Bicycle Coordinator, located in the Highway Department or in the Highway Safety Office. Although they usually do not exert much influence on policy decisions, an increased awareness of bicycling concerns has been achieved through the appointment of professionals to these positions. States are beginning to demonstrate willingness to listen to bicyclists' concerns through "bicycle advisory committees," to assign administrative responsibility for program development, and to commit funds for improvements to the bicycle transportation system.

The majority of bikeway development funds expended in the United States are locally generated. The experience of the FHWA Bikeway Demonstration Program and the comments to DOT by local planning offices indicate that the demand for bicycle transportation program assistance is high at the local level.

The main actors in the private sector are the bicycle industry (manufacturers and retailers), bicyclist organizations, and the media. The industry naturally supports efforts to promote bicycling. Its presence, however, is most felt in areas of child bicycling and adult recreational bicycling. However, the industry does take an active interest in legislation to provide additional funds for bicycle programs and is a strong supporter of safety education for bicyclists.

The majority of cyclist organizations are formed to provide local recreational opportunities. Such groups may take an interest in community bicycle programs, but they are concerned primarily with club activities. Another type of organization is the bicycle advocacy group which is composed of cyclists who act as lobbyists to city hall, to the state government, and to Federal agencies and the Congress. A unique bicycling organization in this country is the League of American Wheelmen. Although its membership appears to be basically geared toward recreational riding, it does have a strong, successful legislative program.

With the current gasoline shortage, the media is evidencing a surge of interest in bicycling as an alternative mode of transportation. Major news dailies and weeklies have devoted considerable space to commuter cycling, rising bicycle sales, problems of cycling in an urban environment, and the types of bicycle programs being implemented by Federal, state and local government.

Non-profit organizations play a variety of roles in relation to bicycling. Groups such as the National Safety Council and American Automobile Association have been responsible for major bicycle safety education programs for children. Many service organizations have focused local attention on child bicycling as a community safety problem. Unfortunately, few have taken any interest in adult bicycle transportation. Some professional associations, such as the Institute of Transportation Engineers, have become interested in bicycle transportation but the majority express general disinterest in what needs to be done.

### C. Obstacles to Increased Bicycle Use

Section 682 of the National Energy Conservation Policy requires the identification of the "institutional, legal, personal and physical

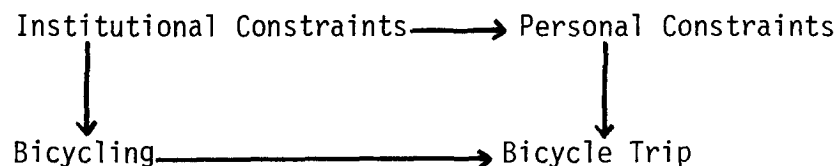


obstacles to increased bicycle use. Not all of the conditions described previously are obstacles to bicycle use. We, therefore, have extracted those conditions which specifically impede bicycle transportation in the U.S. and organized them into a logical framework to clarify the nature and interrelationship of the obstacles or constraints identified.

The basis for this framework is the identification of the arena in which any given constraint operates and the relationship between that constraint and the others which are also at work in that arena. Although the Act specified four specific categories of obstacles--personal, physical, institutional, and legal--it was found that all constraints can be organized into two major categories--those that prevent or discourage a person from choosing to ride a bicycle, and those that constrain an institution from becoming effectively involved in the field of bicycle transportation.

The two remaining categories identified in the Act, however, have not been ignored. Physical obstacles are contained in the personal category since they represent a major factor in an individual's decision to ride and satisfaction with the bicycle mode. Legal obstacles have been subsumed under the institutional category because they represent just one example of the many types of institutional responses which affect bicycling.

These personal and institutional obstacles are closely related since institutional involvement in bicycling can positively or negatively affect the conditions which dictate an individual's decision to ride. A principal distinction between the two is that institutions deal with bicycling on an aggregate basis, while individuals are concerned primarily with isolated bicycle trips. The relationship between the two can be seen below.



In the following sections, the various types of constraints that operate on individuals and institutions will be discussed.

### Personal Constraints

In order for any mode of transportation to be "successful," a large

number of people must regularly choose it over other available modes. With bicycling, however, the choice is not a one-time decision to ride. Rather, that choice is comprised of a series of analyses and micro-decisions concerning the acceptability of bicycling under a specific set of conditions. This study identified a wide range of constraints which can have a significant impact at each decision-making stage. It is important to recognize that potential and existing bicyclists can be blocked or discouraged at any one of these decision points. The obstacles that exist at each of these, therefore, are of equal importance. They will be discussed in some detail in the paragraphs that follow.

#### Low Level of Awareness and Acceptance of Bicycle Transportation.

Unlike mass transit and ride sharing, which have been actively promoted as energy conservation strategies, the bicycle has not received a lot of publicity as a mode of transportation. As a result, the general public is not fully aware that the bicycle is a viable alternative to the automobile for many short-distance trips. Most adults perceive bicycling as an activity that requires enormous physical effort, is only practical for very short distances (i.e., under one mile), is very dangerous, requires expensive equipment and clothing, is limited to only a few months out of the year, and is not in keeping with a "professional lifestyle." Related to these perceptions is a strong belief by many people that bicycles do not belong on the street. This belief appears to be the basis for what many cyclists identify as motorist hostility to bicyclists.

This "mind-set," although inaccurate, is the first major constraint that prevents people from becoming regular cyclists.

Inability to Bicycle Safely and Efficiently. Despite the problem of awareness, there have been many people who have decided to try bicycling to work or on errands. The next problem this group encounters is their own fear of riding in traffic. Because of the well established belief that bicycling is something learned in childhood and never forgotten, few adults recognize the need to obtain some form of training in the operation of their bicycle in traffic before attempting regular commuting. Without proper training, novice cyclists very quickly encounter situations which are beyond their basic skill level. It is at this point that they do not feel capable of handling regular traffic situations.

Another area that causes problems for new cyclists is ignorance about equipment and route selection, and maintenance and repair. Although actually rather straight-forward, bicycle commuting has been surrounded with a mystique of special equipment, elaborate maintenance procedures, and "scientific" route selection. These are areas that would need to be addressed in training programs in order to get cyclists over the "skill and knowledge" obstacle.

Lack of Provisions for Cycle Use. There are three major constraints in the area of physical facilities: lack of safe, direct routes; inadequate bicycle parking; and the restriction of bicycle/mass transit interface. These constraints severely limit the opportunity to bicycle for the average citizen.

Other Disincentives. Any one of the above categories of obstacles can actually prevent an individual from riding a bicycle for transportation. There also exists a category of constraints which generally serve as disincentives to bicycling. While no single disincentive would likely cause someone to reject bicycle transportation, a combination of disincentives can constitute an enormous obstacle to all but the most dedicated cyclist.

The disincentives most frequently cited by those who commented to the Department are: (1) perceived motorist insensitivity; (2) lack of shower facilities at destinations, particularly workplaces; (3) difficulty in carrying parcels on bicycles; (4) bottlenecks where bicycle travel becomes inconvenient or awkward; (5) poor directional information for bicycle facilities; (6) limited selection of bicycle designs for comfort, economy, and efficiency; and (7) high volumes of air pollution during peak travel time.

It can be seen that each of these obstacles becomes effective at different stages of a cyclist's development. In that regard, they can be considered sequential in nature. It should be remembered, however, that at any given point in time there are cyclists or potential cyclists being affected by every one of these obstacles. They all are important, therefore, in the consideration of what is needed to increase bicycle use.

#### Institutional Constraints

Just as the obstacles described above restrict the extent to which an individual will bicycle, there is a similar series of constraints which limit the involvement of any institution in bicycle transportation. As with the

personal constraints, the institutional constraints can be viewed as occurring in a sequence. They are as follows:

Low Level of Awareness/Acceptance. The bicycle facility has only emerged as a transportation vehicle in the last decade, and many institutions have been slow to respond to its presence in the transportation system. The first constraint encountered within institutions, therefore, is general lack of awareness and acceptance of the bicycle as a mode of transportation. This low level of awareness has resulted in a reluctance to accept the bicycle as part of an institution's professional responsibility. The bicycle, therefore, has not been fully integrated into general transportation program planning and development.

From the comments received from bicyclists in response to the Department of Transportation's request, it appears that this unwillingness of institutions to become involved in bicycling has a tremendous psychological effect. It reinforces the perception that the bicycle is not a legitimate mode of transportation and that bicyclists are not entitled to the same considerations as other transportation consumers.

Lack of Skill and Knowledge. Those organizations and individuals that do consider bicycle transportation are often unaware of the state-of-the-art in bicycle program development and implementation. As a result, poor quality facilities and programs are developed.

There is also a lack of accepted standards for bicycle facilities and program development. Since few, if any, programs have been evaluated, each program specialist is free to choose any approach which seems reasonable. In the absence of solid information from qualified sources, many professionals rely on their own best judgment when designing a bicycle facility or bicyclist program. While the effort is always well intentioned, it frequently can do as much harm as good, by creating hazardous situations for bicyclists and a bad image for bicycle projects within the institution.

Inadequate Resources. Because of the low priority that is frequently accorded bicycle transportation within most jurisdictions, those organizations which are interested in promoting bicycle transportation or improving bicycle safety frequently have a problem in securing adequate funding for program development and implementation. Current funding programs place the bicycle in direct competition with other highway needs for the allocation

of Federal transportation funds, and provide funds to state governments only. While it is appropriate that the bicycle not be given extraordinary preference over other recognized priority areas, such a funding policy does not take into consideration the needs of local governments which carry the major responsibility for dealing with bicycle transportation.

A related resource problem is the constraint of staffing. Since bicycle transportation is a low priority area, there frequently are insufficient personnel assigned to it. This has been cited as a major problem in bicycle enforcement.<sup>36</sup> Those who are assigned responsibility frequently are low ranking staff members who are expected to fit it in along with several other areas of responsibility. The shortage of staff time devoted to bicycle programs results in a slow response time to bicyclists' needs and a poor community image for the agency.

Lack of Communication and Coordination. In many ways, the field of bicycle transportation can be viewed as being in its infancy. A notable characteristic of this stage of its development is the lack of communication among professionals and the poor coordination of planning and program implementation.

At the DOT/CPSC-sponsored Conference on Bicycle Education (BIKE-Ed 77) and the Regional Workshops on Bicycle Safety, the most often repeated request was for information on what is being done around the country. Professionals are particularly in need of documentation of successful programs and analyses of the causes of the failures. Many local program specialists are also unaware of the work done by the Federal Government because research reports frequently do not filter down to this jurisdictional level.

Coordination is a problem at all levels of government and within the private sector. The lack of coordination appears to be the result of the fact that there is no single agency or individual responsible for overseeing the community's bicycle program. Many opportunities for integration of bicycle transportation into the regular activities of agencies such as Public Works are lost because there is no one in those agencies to insure that the bicycle is even considered. This problem results in overlapping responsibility, duplication of effort, and neglected program areas.

<sup>36</sup> Vincent S. Darago, Regional Workshop on Bicycle Safety: Presentations, Participant Problems, Programs and Ideas, and Recommendations, National Highway Traffic Safety Administration, Contract DOT-HS-7-01798, September 1978.

As was the case with the personal constraints, an institution would proceed through each of these obstacles in sequence as its involvement with bicycle transportation increased. Any one of these obstacles, however, could limit or reduce the effectiveness of that institution in responding to the needs of bicycle users. It is in this regard that these obstacles have the potential of directly affecting bicycle transportation. There is no one institutional obstacle that is more important than any other and all should be addressed simultaneously by a comprehensive program to increase bicycle transportation in the United States.

#### D. Summary

The obstacles described above represent general categories of constraints which have been identified by cyclists themselves, bicycle program specialists, and government researchers. Their significance to this report is two-fold. First they serve as the starting point for the development of the comprehensive program to increase bicycle transportation. Personal attitudes, skill levels and funding opportunities are the types of problems that need to be addressed in order for there to be any substantial switch to the bicycle from other transportation modes. Secondly, the organization of the obstacles into the sequence in which they become significant to an individual or to an institution provides a conceptual framework with which to implement and monitor the progress of the comprehensive program. In other words, if the program is designed to attract new riders, attention first must be paid to changing attitudes about bicycling. The condition of commuter bicycle streets, however, must be recognized as a priority concern for those who have already decided to bicycle but are having difficulty finding suitable routes.

In the next chapter of this report, these obstacles will serve as the basis for the development of objectives and program elements for the comprehensive program to increase bicycle use.

### III. COMPREHENSIVE BICYCLE TRANSPORTATION PROGRAM

#### A. Introduction

Section 682 (b) of the National Energy Conservation and Policy Act directed the Department of Transportation to develop a comprehensive program to reach a target goal for bicycle use in commuting. In developing the program, "consideration should be given to educational programs, federal demonstrations, planning grants and construction grants."

We have interpreted this as a request for a national program to encourage the increased use of the bicycle as a mode of transportation. Responsibility for implementing such a program would be shared among the Federal, state and local levels of government and the private sector. Since it would have been beyond the scope of this study to dictate specific actions for each of the many organizations and jurisdictions involved in bicycle transportation programs, the Comprehensive Bicycle Transportation Program is being presented as a series of performance guidelines indicating what conditions must exist by 1978 for there to be a substantial increase in bicycle transportation in this country. Additionally, some suggestions are provided as to how a particular guideline could be implemented and what actors would be involved.

In the sections that follow, the steps followed in the development of the Comprehensive Program are discussed and each of the elements of that program is described.

#### B. Objectives

Since the maximum reduction of energy consumption comes from bicycle transportation rather than bicycling for recreation, it was determined that the goal for the Comprehensive Bicycle Transportation Program should be to increase the use of the bicycle as a mode of transportation.

The framework of personal and institutional obstacles was used as the basis for the development of objectives for the Comprehensive Bicycle Transportation Program. Four major objectives were identified:

1. To Improve Operator's Awareness of and Competence in Bicycle Transportation. This objective is based on the first two personal

obstacles--low level of awareness and acceptance of bicycle transportation, and inability to ride safely and efficiently. The words "operator competence" describe the desired end product: (a) individuals who have overcome their negative attitudes and fear about bicycle transportation to become competent bicycle operators, able to handle most, if not all, traffic situations; and (b) motorists who have overcome their hostility towards the bicycle as a mode of transportation and have developed the appropriate new skills required to share the road safely and efficiently with bicyclists.

2. To Increase Institutional and Professional Responsiveness to Bicycle Transportation. This objective addresses the entire range of institutional constraints (level of awareness/acceptance of bicycle transportation, skills and knowledge, resources and coordination/communication).
3. To Improve the Transportation Infrastructure. This objective addresses the obstacles affecting the opportunity to ride and the other disincentives. It encompasses all modifications to the actual road environment (separate and shared facilities), provision of support facilities (parking and showers), expansion of bicycle/mass transit interface opportunities, and distribution of information pertaining to the transportation infrastructure.
4. To Improve Product Design. This rather specific objective addresses some of the obstacles encompassed under "general disincentives," since problems with vehicle design affect most significantly the ease with which a person may cycle around town. While the primary concern of this objective was bicycle design, it was felt that improvements to the automobile also might have a measurable impact on bicycle use through the reduction of certain disincentives such as air pollution.

### C. Critical Factors

The next step in the development of the Comprehensive Bicycle Transportation Program was the identification of the principal sub-objectives or factors which must be addressed in order to achieve the



overall goal of increased bicycle use. We identified a total of 107 critical factors which should be at least considered in a program to increase bicycle use. These factors were organized into a hierarchical structure of objectives and sub-objectives. This hierarchy is shown in Figure III-1.

Once the hierarchy was created, each factor identified was evaluated according to its relative importance in increasing the use of the bicycle as a mode of transportation. The score assigned to each item on the "tree" was used as the basis for selecting "critical factors" to be addressed in the Comprehensive Bicycle Transportation Program.

The process used for this analysis was the Worth Assessment Procedure developed for the Air Force by J. R. Miller in 1967 to aid in the selection of strategies from a set of complex alternatives. In this project, it allowed for the integration of the expertise of individuals in a range of fields, and for the systematic analysis and comparison of a large number of alternative strategies.

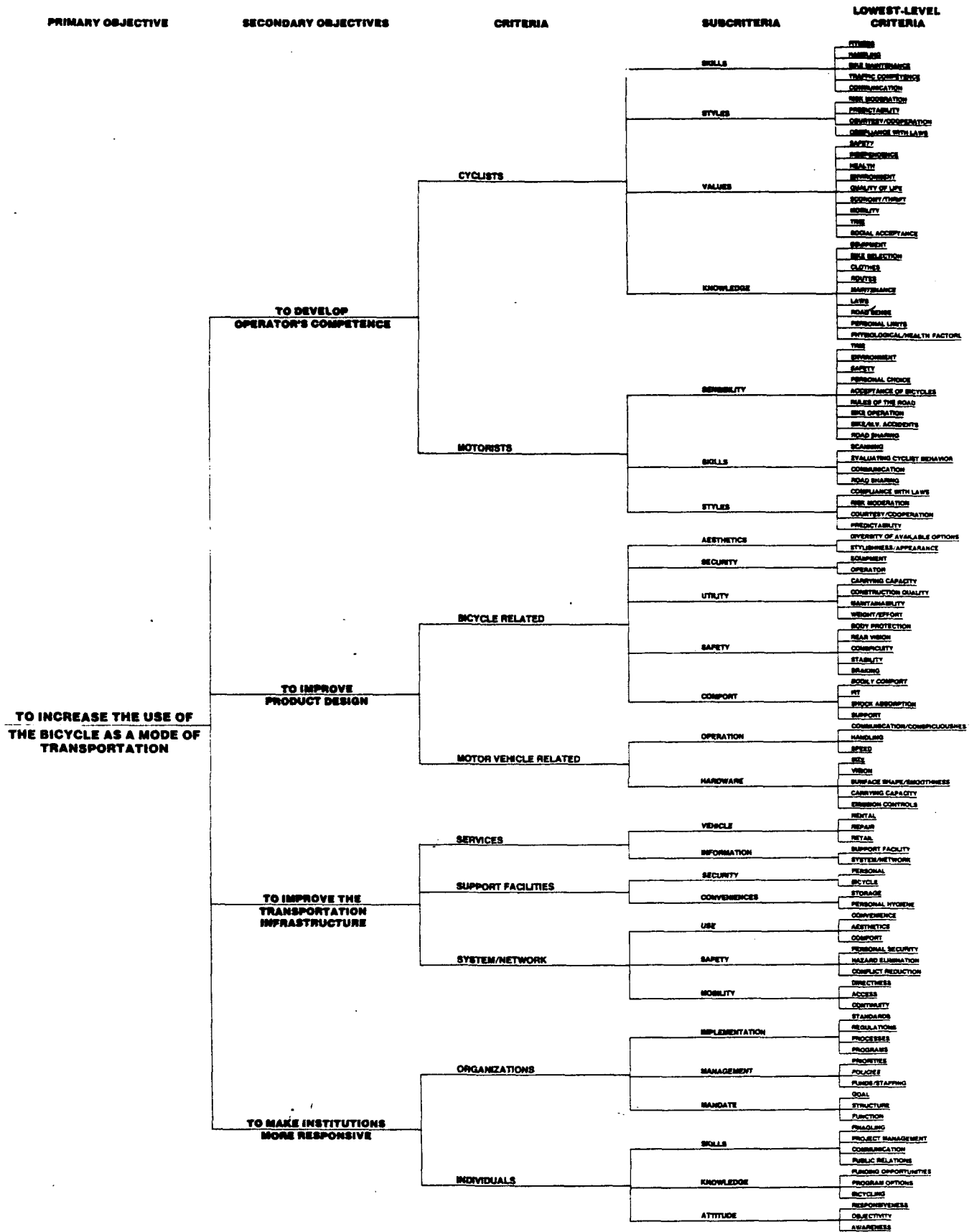
In order to accomplish this, we solicited the assistance of state and local bicycle program specialists and leaders in private industry, transportation planning, and public administration.

The following people contributed their time to the successful completion of this task:

Bicycle Program Specialists

Dick Rogers, California Department of Transportation  
Ron Thompson, Bicycle Coordinator, Wisconsin  
Josh Lehman, Bicycle Coordinator, Seattle  
Cathy Buckley, Boston Central Transportation Planning Staff  
Ralph Hirsch, Legislative Representative, League of American Wheelmen  
Ken Cross, Anacapa Sciences  
Alex Sorton, Northwestern University Traffic Institute  
Bruce Burgess, Bicycle Program Consultant  
Charles McCorkell, Transportation Alternatives

Figure III-1



WORTH ASSESSMENT STRUCTURE -- BICYCLING

### Institutional Decision-Makers

Mitch Tyson, Assistant to Senator Paul Tsongas  
Miriam Block, Councilwoman, Raleigh, North Carolina  
Malcolm Murray, Special Assistant of Governor Lamm of Colorado  
Peter Koltnow, Executive Director, Highway Users Federation  
Tedson Myers, Attorney, Washington, D. C.  
Harry Shaw, President, Huffy Corporation  
James Matthews, Special Assistant to Governor Babbit of Arizona  
Governor Bruce Babbit, Arizona

The results of the scoring process are illustrated in Figure III-2.

As a result of the scoring process, one major branch of the tree, Product Design, was dropped from consideration. The score it received was so much lower than the other three objectives, that it was determined that it could not make a noticeable contribution to increasing bicycle use.

Out of the possible 107 items identified by Mountain Bicyclists' Association, our group of experts selected 19 which need to be addressed in a Comprehensive Program. These items and the obstacles and objectives to which they relate are listed in Figure III-3.

#### D. Program Elements

The final step in the development of the Comprehensive Bicycle Transportation Program, the identification of program elements, gives us the opportunity to organize into a single entity the results of research and the program experience of state and local agencies in the field of transportation. Specifically, the elements chosen for this program represent a summation and refinement of the ideas presented in: Bike-Ed 77, A Conference Report; Regional Workshops on Bicycle Safety: Final Report; The Bicycle Guide (Draft); Bicycle Information Report (Draft); a variety of smaller studies; correspondence with several bicycle transportation professionals; and the over 500 letters received by the Department in response to the request for comments published in the Federal Register.

The effectiveness of these program components in increasing bicycle use has not been evaluated to date. It is our belief, however, that the selection of these elements is based on the best available data, and that they constitute a reasonable approach to increasing the use of the bicycle for transportation.



What follows is a general discussion of the MBA's recommendation for a Comprehensive Bicycle Transportation Program to increase bicycle use. The elements are organized according to the program objective which they address and are presented in the order of their importance in the previously cited references. Rather than specify exactly what has to be done by each organization involved at each jurisdictional level, the program elements are presented in the form of performance recommendations for achievement by 1985.

#### To Increase Operator Competence/Awareness

The following five elements address the issue of operator competence.

Comprehensive Adult Bicyclist Education/Training. Both introductory and indepth bicycling education programs should be made available to all adults. The program would attempt to correct cyclists' styles of operation, particularly concerning compliance with the laws and the predictability and riskiness of behavior. The program would include on-bike training in traffic skills and bicycle handling, and classroom instruction in "road sense," route selection, rules of the road, and equipment choice and maintenance. This program could be made available in condensed form to employees at their work sites, in full-length version to high school and college students through physical education programs, and in varying lengths to interested adults through community adult education, service organizations, and other programs.

The program could be developed by the private sector and its implementation financed in part by private industry, the Federal Government, and state and local funds.

Public Information/Awareness. The most efficient means of increasing the awareness and acceptance of bicycling is to use the mass media, including television, radio, newsprint, and direct mail. This will acquaint people with the benefits of cycling and increase acceptance of the bicycle as a legitimate and viable mode of transportation. The key message should encourage people to consider bicycling. The image conveyed through the program must depict people of a variety of ages, income levels, and professions bicycling to work, to school, or to the store. Well known individuals should publicly proclaim their support of bicycling, and elected

and appointed officials should be shown riding bicycles to work. Bicycling must be portrayed as a regular, rather than unusual, activity, and bicyclists depicted as normal individuals making a valuable contribution to society.

Motorist Information Program. While motorists would be affected by a broad-based public awareness program, they have special information needs that must be addressed in a more targeted program. The delivery of information to motorists should begin when they prepare to obtain licenses and should continue throughout their driving career.

Information related to bicycle operation and road-sharing techniques should be included in driver's education curricula and in state-issued driver's manuals and licensing written exams should have questions related to motorist-bicyclist interaction. Behind-the-wheel training should include practice in scanning for bicycles, evaluating bicyclists' behavior, and sharing the road with a variety of vehicles.

An ongoing campaign to provide all motorists with critical information related to bicyclists' use of the roadway should be instigated. Such information could be distributed through flyers enclosed with license renewal and vehicle registration letters and through media campaigns directed specifically to motorists.

Selective Enforcement of Traffic Laws. Local police departments should conduct regular enforcement campaigns targeted at the most critical violations (in terms of car/bicycle accident causation) of both bicyclists and motorists. This type of program could concentrate on bicyclists riding against traffic, disregarding traffic signals and stop signs, and not lighting bicycles at night, and motorists failing to yield to bicyclists at intersections. This would educate both motorists and bicyclists in the rules of the road and would eliminate much of the illegal operation by bicyclists. Such a program must be accompanied by a responsive judicial policy and by the development of appropriate fines and penalties for an adult population.

The major burden of responsibility for this element will lie with local jurisdictions with appropriate support provided by state and Federal agencies.

Bicycling Incentives. The elements discussed above are designed to increase the social acceptance of bicycle transportation and to improve the

skills and knowledge of current and potential cyclists so that fears about bicycling can be reduced or eliminated. Other ideas can serve as incentives to make it easier for people to ride their bicycles to work, to school, and on errands.

The objective for incentive programs would be either to benefit all employees equally or elevate bicyclists to the same level of benefits enjoyed by automobile commuters. Incentives would include widespread adoption of flexi-time, reimbursement for use of bicycles for business trips, subsidized or free high-security bicycle parking, purchase of a company bicycle fleet for use on local business errands, life and automobile insurance premium discounts for regular bicycle commuters (as for non-smokers), and the provision of showers and lockers for employees who bicycle, walk, or run to work.

#### To Increase Institutional and Professional Responsiveness

Funding Programs. Adequate funding is a prerequisite for any comprehensive program to increase bicycle transportation. Funding may come from a variety of sources and in a range of forms. At the Federal level, full funding of the currently authorized bicycle grant program (Sec. 141 of the Surface Transportation Assistance Act of 1978) is proposed to help to eliminate primary obstacles to bicycle commuting (e.g., roadway hazards, lack of cyclist training, lack of downtown bicycle parking). The Section 141 program authority is ideally and uniquely suited to this purpose in that it provides for both construction and non-construction projects which will enhance the use and safety of bicycling. This flexibility is essential to efficient, effective support of state and local government efforts.

The overall purpose of this element is not to furnish extraordinary funds to bicycle programs, but to give strong support for basic projects which will enable bicyclists to share the road with other modes.

Standards and Guidelines. Because of the relatively recent interest in the development of bicycle facilities and other bicycle programs, many projects are planned/designed by individuals with little or no prior experience in such activities. It is critical, therefore, that clear, up-to-date standards or guidelines, reflecting the best state-of-the-art, be available to guide these efforts. The Federal Highway Administration currently is preparing guidelines for bicycle facilities. Other aspects of bicycle programs should also be addressed. This can best be accomplished as a cooperative effort of Federal, state and local governments bicycle program

specialists and the various professional associations with an interest in this area.

Also, policies, standards and guidelines for transportation system planning and facility design and construction should include explicit consideration and appropriate integration of provisions for the needs and requirements of cyclists. This would apply to such things as FHWA's consideration of the American Association of State Highway and Transportation Officials' forthcoming "Policy on Geometric Design of Highways and Streets."

Integration of Bicycling into Planning Efforts. If special funding is the key to implementing bicycle transportation programs, then the full integration of bicycling into all governmental planning processes is the key to sustaining them. This involves: (1) the addition of bicycle transportation to governmental policy agendas; (2) the establishment of a Federal requirement concerning the treatment of bicycles in Federal, state, and local planning efforts (i.e., transportation, air quality, energy conservation, highway safety, urban development); (3) the enforcement of that requirement through comprehensive program/policy review; and (4) the recommendation by professional associations and quasi-governmental organizations (including Institute of Transportation Engineers, American Society of Civil Engineers, AASHTO, Conference of Mayors, National Association of Counties) that bicycles be given serious consideration in all program planning, design and implementation.

Two problems arise in this area. First, the low level of response to the Transportation System Management requirement that pedestrians and bicycles be considered in transportation plans is not adequate for this program to increase bicycle transportation. Every effort must be made to insure, through rigorous program review, that bicycles are given thorough consideration. Second, integration of bicycle considerations should go beyond the addition of a bikeway plan to the Transportation Improvement Program of a community. Full integration of bicycle transportation necessitates, for example, an assessment of the positive and negative impacts on bicycle safety and access of any proposed transportation project.

This distinction between a "bicycle add-on" and full integration is an important one. Full integration opens the door to a wide range of opportunities for incidental improvements for bicycling that would not



even be considered if bicycle transportation was set apart from other modal planning (e.g., FHWA's 3R and Bridge Rehabilitation Programs).

#### Improved Coordination of Governmental Bicycle Transportation Activities.

A major institutional problem which has been identified is the poor coordination of bicycle transportation programs at all levels of government. Within various agencies, there is frequently no individual responsible for coordinating programs that are or should be taking place. Individuals and even agencies, operating in isolation, may respond to bicyclists' demands in a project-by-project basis, but often lack the authority and enthusiasm to develop a comprehensive plan for integrating the bicycle into their program area. On a broader scale, there usually does not exist an individual or agency in a position to oversee an entire jurisdiction's response to bicycle transportation. As a result, there is duplication of effort, program funds are wasted, and frequently programs are developed and implemented by inappropriate agencies.

Therefore, a framework for coordinating the development and implementation of bicycle programs should be established at each level of government. This arrangement could include: (1) a bicycle coordinator in each appropriate agency; (2) an inter-agency bicycle task force to insure that bicyclist needs are being adequately addressed by all agencies; and (3) bicycle advisory groups, representing the interests of all cyclists, to assist in the identification of problem areas, the development of program solutions, and the evaluation of program effectiveness.

#### Improved Awareness and Acceptance of Bicycle Transportation by Professionals

Just as it is necessary to improve the public perception of bicycling, organizations and professionals involved in bicycling programs should be encouraged to consider bicycle transportation a legitimate and important area of responsibility. This involves a change in attitudes or perceptions that can be brought about through: (1) the distribution of information packages describing the societal benefits of cycling; (2) the publication of bicycle-related articles in professional journals; (3) the acknowledgement by professional associations of the importance of bicycle program specialists; and (4) the inclusion of bicycle-related material in professional training curricula.

### Increase in Knowledge of Bicycle Program and Funding Opportunities.

Related to improvement of attitudes is increase in knowledge through the dissemination of information on bicycling needs, program options, technical resources, and funding opportunities to professionals who are or should be involved in bicycle transportation. The first step in this process should occur in undergraduate and graduate professional training. Information related to the value to bicyclists of wide curb lanes or paved shoulders, for example, should be included in traffic engineering curricula and texts. This early orientation to bicycle considerations not only provides technical information, but also legitimizes bicycle transportation in the eyes of new professionals.

In-service training keyed to bicycle programs should be made available to all program specialists. A professional journal dedicated exclusively to bicycle programs to maintain regular lines of communication among the professional community should be supported by all levels of government.<sup>37</sup>

### To Improve the Transportation Infrastructure

Three program elements have been developed to improve the transportation infrastructure.

The Elimination of Surface and Design Hazards. While bicyclist training programs should prepare cyclists to recognize and avoid hazards, bicycle commuting will not increase significantly until the transportation system is made as hospitable and hazard-free for the bicyclist as it is for the motorist. Removing hazards can be accomplished by local governments with the technical assistance and financial support from state and Federal agencies.

Particular emphasis should be placed on providing funds and establishing guidelines for the modification of existing street systems. However, when serious hazards on an existing street cannot be eliminated and when no suitable alternate route exists, a special bicycle facility to bypass the hazard should be considered. This approach should be taken only when less costly, more efficient options are not available.

---

<sup>37</sup>The Bicycle Forum is currently filling this need.

Regular maintenance is important since the bicycle is more vulnerable to surface irregularities and debris than the automobile. Maintenance of separate facilities must be included in normal maintenance schedules. This requirement also should be considered in the initial design of separate bicycle facilities so that surface and clearance provided will accommodate maintenance vehicles.

Improvement of Bicycle Access. Direct bicycle access is essential to a bicycle commuting program. A good route is one that is reasonably direct, free from frequent delays, and devoid of bottlenecks that adversely affect convenience or safety.

As with hazard elimination, improving access is primarily a local responsibility. It begins with a thorough analysis of the transportation system with regard to bicycle service. Particular attention must be paid to: (1) natural or man-made barriers (rivers, expressways, tunnels); (2) interrupted bicycle routes; (3) awkward intersections; (4) traffic signals that do not respond to bicycles; (5) the accommodation of bicycles by the mass transit system; (6) the suitability of major streets for bicycling (lane width, shoulder condition, traffic volume, speed limit); and (7) the quality/adequacy of existing separate bicycle facilities. Once the current situation has been assessed, steps can be taken to improve the existing conditions in order to provide full, convenient access to all bicyclists.

Some access problems will not be solved by improving the existing roadway system. In such cases, it may be desirable to provide a special bicycle facility to bypass the obstacle or to connect two major system segments. Special facility construction may also be useful to provide safe shortcuts for cyclists. However, special facilities should be considered as the exception rather than the rule in a comprehensive bicycle transportation system.

All highway construction projects should be examined to insure that bicycle access is not reduced or eliminated. Federal and state project requirements and funding policies can be used to accomplish this.

Multi-modal opportunities (bicycle/bus, bicycle/subway) offer potential for both reducing the number of short automobile trips (home to the station) and increasing the potential range of bicycle trips. Unfortunately, these

opportunities are limited severely by the lack of secure bicycle parking at the transit stations and by the inability of most mass transit vehicles to accommodate bicycles. Funding policies and design guidelines should be adopted to encourage this service. In particular, secure, adequate bicycle parking should be required and consideration should be given to carrying bicycles on mass transit at least along certain routes or at certain hours.

A critical factor in access is the cyclist's awareness of good bicycle routes. A major concern of local communities therefore should be: (1) the development of system-wide maps that identify recommended streets, separate facilities, and bike lanes, and help in route selection by locating hazardous intersections and steep grades; and (2) the installation of functional directional signing along bikepaths, bike lanes, and bike routes.

Provision of Bicycle Parking. Secure bicycle parking is necessary for a commuter or shopper to consider bicycling as a viable transportation mode. Bicycle parking is essential at all employment centers, shopping centers, downtown business districts, and mass transit stations.

This can be accomplished at the local level by passing ordinances that would require bicycle parking facilities to be provided in conjunction with all new public construction projects. Municipal "parking lots" for bicycles can be established in downtown locations, while local retailers and industry can be encouraged to provide bicycle parking for their employees and customers.

At the state and Federal levels, standards concerning the design and location of parking facilities can be established. Mass transit bicycle parking facilities can be mandated by requiring that all Federally funded projects include secure, weather-protected storage at all stations. Pending national legislation requiring the provision of secure parking facilities at all Federal installations should be passed, and Federal employees should be urged to commute by bicycle, providing a positive example to other jurisdictions and to the private sector.

#### E. Summary

A comprehensive program to increase the use of the bicycle as a mode of transportation would be designed to accomplish the following objectives:

1. to improve operator's awareness of and competence in bicycle transportation,
2. to improve the transportation infrastructure, and
3. to increase institutional and professional responsiveness to bicycle transportation.

The following elements should be included in this program:

- Operator's Competence and Awareness (Bicyclists and Motorists)
  - Adult bicyclist education/training
  - Public awareness campaign
  - Motorist information program
  - Selective enforcement of traffic laws
  - Bicycling incentives
- Institutions and Professionals
  - Funding programs and policies
  - Program standards and guidelines
  - Integration of the bicycle into government planning efforts
  - Improved coordination of governmental bicycle transportation activities
  - Improved attitudes of professionals towards bicycle transportation
  - Increase in knowledge of bicycle programs and funding opportunities
- Transportation Infrastructure
  - Elimination of surface and design hazards
  - Improvement of bicycle access
  - Provision of bicycle parking

It is our belief that the implementation of this program nationwide, with the full support of the agencies and organizations involved at the national, state and local levels, will result in a substantial increase in the use of the bicycle as a mode of transportation. Our estimates concerning the impact of this program on bicycle use and its potential benefits for energy conservation and air quality improvement are described in the following chapter.

## IV. POTENTIAL USE

### A. Introduction

Section 682 of the National Energy Conservation Policy Act requires in part that the Department of Transportation "... establish a target for bicycle use in commuting." We have expanded this to address potential levels of bicycle use for all transportation trips. The reasons for this expansion is that the Comprehensive Bicycle Transportation Program, described in Chapter III of this report, can be expected to result in an increase in the use of the bicycle for shopping, personal business, social, and recreational trips, as well as for commuting trips. Any diversion from automobile to bicycle for these trips can also be expected to result in gasoline savings.

The following discussion addresses the development of the estimate of the potential level of bicycle use in 1975, and the determination of the effect of this increase on gasoline consumption and air quality.

### B. Potential Commuter Use

The major potential markets for achieving any shift to the bicycle for work trips are the current automobile users and mass transit users. In order to determine the probable number of these commuters who could switch to a bicycle for their work trip, several factors which place limitations on bicycle commuting were considered:

- the characteristics of the commuting trip,
- the need for an automobile during the day,
- the physical limitations of the potential cyclists, and
- the environmental conditions in the regions where the commuting trips will be made.

The following paragraphs describe the effects of these factors on the number of commuters that might switch to the bicycle from other modes.

Trip Characteristics. The Census Travel-to-Work data indicate that only 10 percent of bicyclists commute at speeds above 15 mph, and only four percent travel further than six miles one way from home to work. It was

assumed therefore that any increase in bicycle commuters will come primarily from those auto and public transit users who are presently travelling six miles or less at speeds of 15 mph or less. Table IV-1 shows the percentage of users of each of these modes who fall into that category.

Table IV-1

Commuters with Trips within Bicycling Range<sup>38</sup>  
Distance  $\leq$  6 miles and speed  $\leq$  15 mph

<u>Mode</u>	<u>% of Total Mode Users</u>	<u># of Individuals (millions)</u>
Automobile	18.8	11.6
Public Transportation	41.3	1.9
		<u>13.5</u>

Automobile Dependency. Various types of employment require the use of an automobile. In the absence of a reliable estimate of the number of commuters who are in need of an automobile during the day, we have accepted as a surrogate measure the number of people who have no fixed place of work, and therefore can be considered to have a significant need for an automobile. In the 1975 Travel-to-Work Survey, this number was reported as being eight percent of all commuters.

Physical Limitations. It is possible to synthesize an estimate of the effect of physical limitations on the potential number of new bicycle commuters by defining the target group of bicycle commuters as those individuals between 19 and 45 years of age. Nineteen is the lower limit to reflect the definition of work trips as opposed to school trips. While it is recognized that many individuals older than 45 are capable of regular bicycle usage, this age ceiling was established to take into consideration those under 45 who are physically handicapped or otherwise unable to ride a bicycle. The group within this age category constitutes 60% of the commuter population, according to the 1975 Census figures, leaving 40% who will not be able to ride due to physical limitations.

<sup>38</sup>Based on Travel-to-Work Supplement to the Census Bureau's Annual Housing Survey for 1975.

Environmental Conditions. The effect of environmental conditions, such as climate and terrain, can be estimated by analyzing the regional variations in bicycle commuting reported in the 1975 Census data. The West exhibited the highest percentage of regular bicycle commuting (1.2% of all commute trips or twice the national average). If the West is used as a baseline (i.e., assuming that it represents the best general environmental conditions for bicycling in the United States), the effect of environmental conditions in the rest of the country can be estimated by comparing the 1975 reported level of bicycle commuting in each region to that baseline. Using this process, it was determined that environmental conditions would result in a net reduction of 50% in the number of commuters who could switch to a bicycle.

Estimated Potential Use. As summarized in Table IV-2, applying each of these factors in sequence to the estimated potential market of 13.5 million automobile and transit commuters (calculating for auto and transit users separately), leaves an estimated target group of 3.8 million potential bicycle commuters (3.2 million automobile users and 0.6 million transit users).

Table IV-2

Estimate of Potential Bicycle Commuters (1975 base)  
(in millions)

	<u>Automobile</u>	<u>Public Transportation</u>
Commuters with trips within bicycling range (per Table IV-1)	11.6	1.9
Reductions for:		
- Auto dependency (8%)	- 0.9 <u>10.7</u>	-
- Physical limitations (40%)	- 4.3 <u>6.4</u>	- 0.8 <u>1.1</u>
- Environmental conditions (50%)	- 3.2 <u>3.2</u>	- 0.5 <u>0.6</u>
<u>Estimated potential bicycle commuters by current (1975) mode</u>	3.2	0.6



Target Goal for Bicycle Commuting. Mountain Bicyclists' Association believes that a reasonable goal for the Comprehensive Bicycle Transportation Program would be one to two million additional bicycle commuters by 1985.

C. Potential Use of the Bicycle for Other Trip Purposes

As shown in Chapter II of this report, the bicycle is currently being used for transportation by a substantial number of people. Purposeful bicycle trips, other than commuting trips, can also represent fuel savings since some of these trips would likely be made by automobile if the bicycle was not available. It is anticipated that the Comprehensive Bicycle Transportation Program will result in an increase in the number of these non-commuting trips made by bicycle. Data comparable to the Census data are not available to estimate potential use for these other trip purposes. However, we believe an average increase of approximately 50 to 100 percent over 1975 levels in the use of the bicycle for each of the other bicycle trip purposes is a reasonable goal.

Based on this analysis, if the goal for the Comprehensive Bicycle Transportation Program is achieved, a reduction of 8.3 to 16.5 million miles of daily automobile travel will result. Table IV-3 summarizes these estimates.

D. Potential Energy Savings

If the goal for the Comprehensive Bicycle Transportation Program is achieved, the projected reduction in daily automobile travel of 8.3 to 16.5 million miles by 1975 should result in a substantial gasoline savings. We have conducted the following analysis in order to determine the extent of that potential savings.

The Department of Transportation has established a 27.5 mpg "Corporate Average Fuel Economy Requirement" for 1985. Since nearly two-thirds of all travel is produced by vehicles from the most recent three to four model years,<sup>39</sup> it is estimated that the overall average fuel economy for automobiles in service in 1985 will be approximately 22 mpg. However, automobiles are

---

<sup>39</sup>Alexander French, Transportation Energy Considerations in the Urban Environment, Highway Statistics Division, Federal Highway Administration.

Table IV-3

Estimated Daily Reduction in Automobile Miles Traveled<sup>a</sup>

Trip Purpose	New Bicycle Trips <sup>b</sup> (millions)	Prior Mode Auto (%)	Average Trip Length <sup>c</sup> (miles)	Reduction in Miles (millions)
Work	2.0-4.0	85	1.4	2.4-4.8
School	1.2-2.4	40	2.3	1.1-2.2
Personal Business	2.6-5.2	75	1.5	2.9-5.9
Social	1.3-2.6	75	1.5	1.5-2.9
Recreational	1.4-2.8	10	2.5	0.4-0.7
Neighborhood	2.2-4.4	0	1.5	No auto trips diverted.
TOTALS	10.7-21.4	--	--	8.3-16.5

<sup>a</sup>By 1985 (does not include the 1975 base year use).

<sup>b</sup>One-way

<sup>c</sup>For bicycle trips (from Table II-3)

considerably less fuel efficient on short trips, which will be the ones most likely to be diverted to the bicycle. It has been determined that the relative fuel economy varies with trip length as follows:<sup>40</sup>

Table IV-4

<u>Trip Length (miles)</u>	<u>Relative Fuel Economy<sup>41</sup> (percentage)</u>
.25	10
1.00	25
3.00	45
4.00	55
5.00	60
6.00	65

This would indicate that for the average bicycle trip length of about two miles, the relative fuel economy would be 35% of the overall fleet average. Applying this factor to the estimated 22 mpg fleet average of 1985 yields an estimate of 7.7 mpg for the auto trips diverted to bicycles in 1985.

Using this estimate of fuel consumption for those trips likely to be diverted to the bicycle, we estimate that implementation of the Comprehensive Bicycle Transportation Program, if it achieves its goal, would result in a range of gasoline savings of 1.1 to 2.1 million gallons per day. This would be equivalent to 7.9 to 15.0 million barrels per year.

To determine the total contribution of bicycle transportation to energy conservation in 1985, it is necessary to combine the savings from the anticipated increase in bicycle use and the savings resulting from 1975 bicycle use. This calculation is shown in the following table.

<sup>40</sup>T. C. Austin and K. H. Hellman, "Passenger Fuel Economy as Influenced by Trip Length," paper presented at the Automobile Engineering Congress, Detroit, February 1975.

<sup>41</sup>Percent of the overall fuel economy rating for that car of fleet of cars.

Table IV-5

Annual Energy Conservation from Bicycle Use  
(millions of barrels)

<u>1975 Gasoline Savings</u>	<u>Projected Increase</u>	<u>1985 Gasoline Savings</u>
8.5	7.9 - 15.0	16.4 - 23.5

The 1985 energy savings would be approximately 55,000 to 78,000 barrels per day. This figure can be compared to the expected savings of 262,000 barrels per day from ride sharing, and 302,000 barrels per day from the 55 mile per hour speed limit.<sup>42</sup>

E. Potential Air Quality Improvement

Potential reductions in daily national automobile air pollutant emissions for the year 1985 have also been calculated. Ranges of possible reductions in nitrogen oxide, hydrocarbon, and carbon monoxide emissions are presented in Table IV-6. Emission reduction estimates were derived using emission factors from the EPA publication "Mobile Source Emission Factors," EPA-400/9-78-005.<sup>43</sup> Relevant calculation assumptions are listed in Table IV-6 footnotes.

For comparison, total maximum potential reductions are presented again in Table IV-7 along with 1978 national total emissions and those from light duty mobile sources.<sup>44</sup> Potential reductions, had they been realized in 1978, would have resulted in almost a half of a percent net reduction in total national carbon monoxide emissions with lesser reductions for other pollutants. These figures indicate that potential bicycle-related emission reductions would have a small impact on overall national pollutant emissions.

<sup>42</sup>These estimates were taken from Energy Conservation in Transportation, U. S. Department of Transportation, May 1979.

<sup>43</sup>United States Environmental Protection Agency, Office of Air and Waste Management, Mobile Source Emission Factors, EPA-400/9-78-005, Washington, D. C., March 1978.

<sup>44</sup>Figures for 1978 are the latest made available by the EPA, Office of Manning and Standards, Monitoring and Data Analysis Division, National Air Pollutant Emissions Estimates, 1970-1978, EPA/4-8-002, Research Triangle, North Carolina (in preparation). No 1985 total emission estimates were found.

Table IV-6

National Daily Emission Reduction Ranges<sup>45</sup>  
Resulting from Increased Bicycle Usage

<u>Trips</u>	<u>Hydrocarbons (metric tons)</u>	<u>Carbon Monoxide (metric tons)</u>	<u>Nitrogen Oxides (metric tons)</u>
Work	15.6 - 31.3	188.4 - 376.8	5.3 - 10.6
School	7.2 - 14.5	87.1 - 175.0	2.5 - 4.9
Personal Business	16.6 - 34.1	228.5 - 468.9	5.8 - 11.8
Social	8.5 - 17.0	17.0 - 234.1	2.9 - 5.9
Recreational	2.2 - 4.4	27.7 - 55.4	.8 - 1.6
<b>Total</b>	<b>50.1 - 101.3</b>	<b>648.7 - 1310.2</b>	<b>17.3 - 34.8</b>

<sup>45</sup>Assumptions: Average speed (automobile)--16 mph, average temperature--50°F, low altitude conditions, starting modes; work and school trips--100% cold, personal business and social trips--25% cold, 25% hot, and 50% stable, recreational trips--50% cold, 25% hot, and 25% stable.

Table IV-7

Present Emissions Vs. Potential Reductions

	Hydrocarbons (metric tons/day)	Carbon Monoxide (metric tons/day)	Nitrogen Oxides (metric tons/day)
Total Emissions - All Sources - 1978 <sup>46</sup>	76,200	280,000	63,800
Light Duty Vehicle Emissions - 1978 <sup>47</sup> (auto, light truck)	16,400	136,000	9,700
Maximum Potential Emissions Reductions (from bicycle use)-1985	101	1,310	35
% Reduction of Light Duty Vehicle Emissions	.6%	.9%	.4%

<sup>46</sup> Includes both mobile and stationary sources. Data obtained from EPA, National Air Pollutant Emissions Estimates 1970-1978.

<sup>47</sup> Ibid.

Comparisons on the basis of gross emissions throughout the country may underestimate bicycles' potential contribution. One may argue that bicycle traffic is primarily local while national emissions calculations are for local and long distance vehicle miles travelled. One may also argue that the bulk of the reductions (from work, school, and some personal business trips) occur during peak emission hours. Finally, one may argue that projections for 1985 emissions reductions cannot be compared directly with 1978 emissions since 1985 values are based on lower per automobile emissions rates. Thus the air quality impacts of increased bicycle usage as presented in Table IV-7 may be understated, particularly for certain local areas. However, the data available for use in this study cannot be used to support or disprove that contention.

#### F. Summary

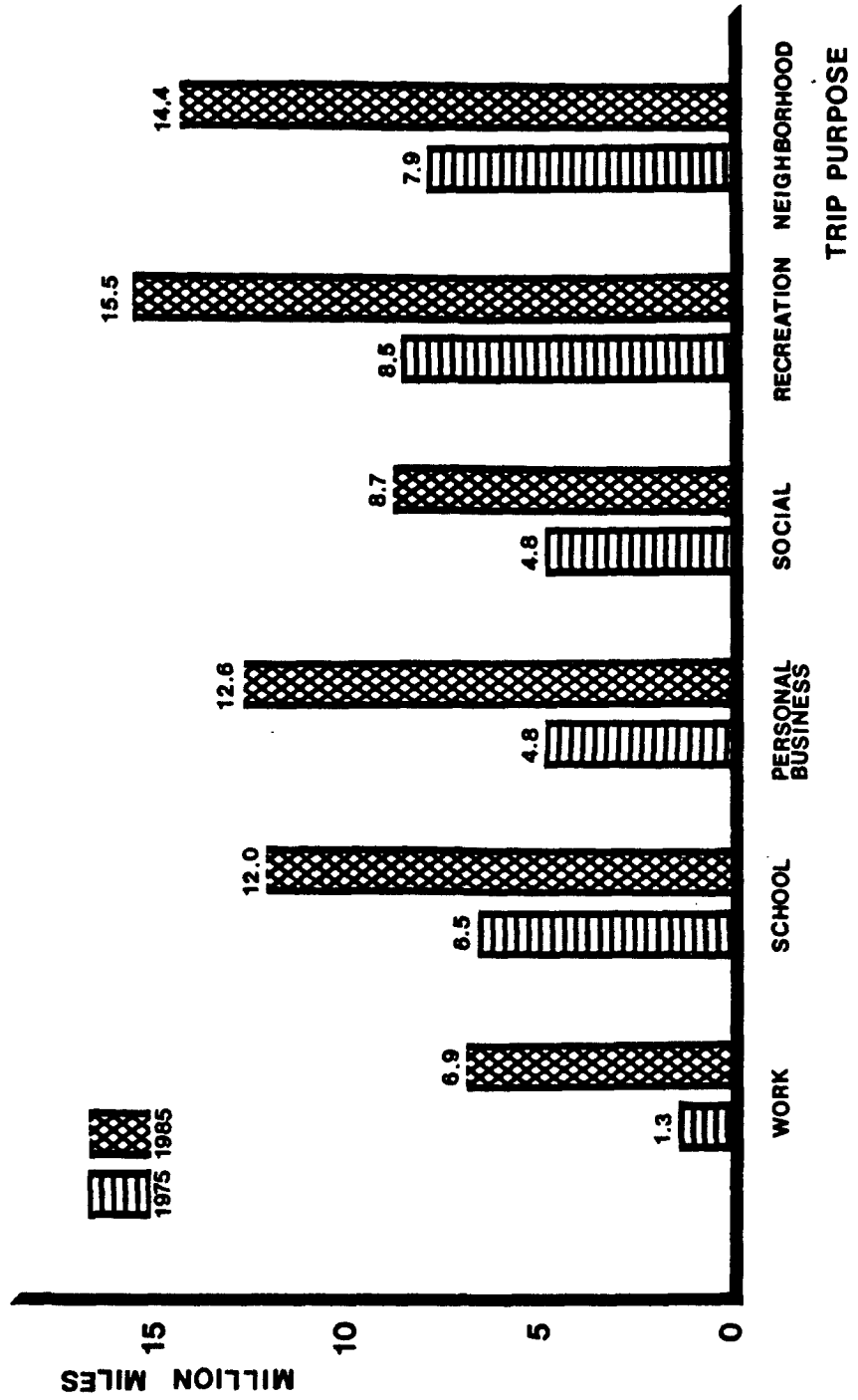
We used the 1975 Travel to Work Supplement to the Annual Household Survey, conducted by the Bureau of the Census, as well as several other regional and local studies to serve as a basis for the estimation of current and potential bicycle use.

Figure IV-1 illustrates the results of our analysis.

The potential reduction in automobile use due to the shift to bicycles is estimated to result in fuel savings in the range of approximately 7.9 - 15.0 million barrels per year (or 26,000 - 50,000 barrels per day). The total energy savings from bicycle use in 1985 could be 16.4 - 23.5 million barrels per year, if the goal for the Comprehensive Bicycle Transportation Program is achieved.

FIGURE IV-1

### Daily Bicycle Miles Travelled by Trip Purpose





## V. RECOMMENDED ACTIONS

### A. Introduction

It is clear from the analysis of current levels of bicycle use that the bicycle is a viable mode of transportation for millions of people for certain trips and transportation needs. For some of these individuals, the young and the poor, it may provide the only means of mobility. But the needs of these cyclists and other potential cyclists are not being met by the current policies and programs of the transportation institutions, and the bicycle has not achieved its full potential as a transportation vehicle.

This section of the report presents a discussion of the roles of the various actors involved in bicycle transportation, with primary attention focused on the recommended policies and actions for the Department of Transportation.

### B. The Role of the Federal Government

The President and the Congress share a limited, though critical, role: to endorse and support, as a national policy, the increased use of bicycles for transportation. This will require a clear, ongoing demonstration of leadership and support, through statements encouraging increased government attention to bicycling, promoting individuals to bicycle more, and supporting requests for the funds required to implement the proposed comprehensive program.

The Federal Government generally has a more direct impact on programs that enhance bicycle transportation than on bicyclists themselves. The role for the Federal Government will be in the areas of:

- standards promulgation,
- funding policies and programs for state and local projects,
- national legislation,
- research, demonstration and evaluation projects,
- technical assistance and information dissemination,
- public information campaigns, and

- the encouragement of bicycling through official endorsement and positive example (i.e., implementation of programs to encourage bicycling among Federal employees),

#### Recommended Actions for the Department of Transportation

Within the Federal Government, the lead role in implementing the Comprehensive Bicycle Transportation Program will be taken by the Department of Transportation.

Recommended Policy. The Department of Transportation has long supported the use of the bicycle as an alternate mode of transportation. Upon consideration of this study, we believe that it is appropriate to redefine the Department's policy to provide for an expansion of its responsibilities in implementing the proposed Comprehensive Bicycle Transportation Program.

We recommend that it be the policy of the Department of Transportation to:

- promote the safe, increased use of bicycles for transportation;
- integrate bicycle transportation into all appropriate Departmental programs and activities; and
- require the inclusion of provisions for bicycles in all appropriate DOT-funded transportation projects.

Within the Department, responsibility for implementing this policy should be shared among the following administrations:

- Federal Highway Administration--general promotional activities, all highway and special bicycle facility-related projects and programs;
- National Highway Traffic Safety Administration--bicycle safety programs, education and enforcement programs for motorists and bicyclists;
- Urban Mass Transportation Administration--bicycle/mass transit interface programs;

- U.S. Coast Guard--integration of bicycle considerations in bridge permit review process; and
- Office of the Secretary--policy development and overall program coordination and review.

The significance of this expanded policy is that it would accord the bicycle full status as a vehicle, place the bicycle mode on a par with other modes such as automobiles, transit, etc., and direct FHWA, NHTSA, and UMTA to address the combined goal of increasing bicycle use and improving bicycle safety.

Recommended Action Plans. In support of this bicycle policy, the Department should take an active role in the implementation of the proposed Comprehensive Bicycle Transportation Program. The actions recommended for the Department are outlined below according to the specific program element they address.

1. Comprehensive Adult Bicyclists Education/Training (\$250 K)<sup>48</sup>
  - o NHTSA should actively encourage the use of highway safety funds (402) for adult bicycle education programs.
  - o NHTSA should publish a summary of bicycle accident research findings in a format suitable for the general public.
  - o NHTSA should sponsor research to develop a bicycle operator's task analysis to serve as the basis for the development of bicycle education programs.
  - o NHTSA should seek Congressional approval for the issuance of a highway safety standard for bicyclist safety which emphasizes the importance of adult cyclist behavior.
  - o The Department should support the development of comprehensive adult bicyclist education programs based in part on NHTSA-sponsored bicycle safety research and encourage its implementation.

---

<sup>48</sup>Cost estimates presented here were developed by MBA as rough estimates of contract costs associated with each comprehensive program element. They do not include DOT staff time or costs borne by other actors. They reflect cumulative costs for the period 1980-1985. These cost estimates are included to provide a reasonable base for an informal cost/benefit discussion on the Comprehensive Bicycle Transportation Program. (See Section F.)

- The Department should encourage other Federal agencies to provide commuter cyclist seminars for their employees.

2. Public Information/Awareness (\$300K)

- The Department should encourage the President to include specific reference to value of cycling in energy and transportation messages.
- The Department should work with the Department of Energy to insure that all Federally sponsored energy conservation media campaigns call attention to the benefits of cycling.
- FHWA should develop model public service announcements encouraging bicycle transportation and make them available to state and local governments for duplication and distribution.

3. Motorist Information Program (\$300K)

- NHTSA should encourage expanded use of 402 funds for bicycle information mail-outs to motorists.
- NHTSA should include guidelines for treatment of bicycling concerns in driver education curricula in the Highway Safety Program Manual for driver education.
- NHTSA should develop model radio psa's alerting motorists to bicyclists' presence on the roadway.
- NHTSA should develop prototype materials to be distributed by Departments of Motor Vehicles with license renewal mailings.
- NHTSA should develop model driver education curriculum components dealing with bicycle concerns.

4. Enforcement/Registration (\$350K)

- NHTSA should actively encourage local police departments to increase the enforcement rules of the road relating to bicycling.
- NHTSA should include elements related to bicycle enforcement and accident records in the bicyclist safety standard.
- NHTSA should develop a model bicycle enforcement manual based on bicycle accident research.

- NHTSA should design a model statewide bicycle registration program.
- NHTSA should conduct evaluations of various enforcement program concepts (i.e., bicycle patrols, enforcement crackdowns) and disseminate results.

5. Bicycling Incentives (\$50K)

- The Department should purchase a fleet of bicycles for local use by DOT employees.
- Each administration within the Department should designate one cyclist employee as contact point for all employee bicycle transportation concerns.
- The Department should insure that secure, protected bicycle parking is provided for both employees and visitors at all Federal-owned or -leased buildings used by the Department.

6. Funding Programs/Policies (\$100 million)

- The Department should request the full appropriation of \$20 million/year for the Section 141 (bicycle program) of the Surface Transportation Act. The primary objective of this grant program will be to eliminate the major obstacles to bicycle transportation. The program should be extended to allow for full funding for five years.
- The Department should require proposed Federal-aid highway projects to assess potential impact on bicycle transportation.
- The Department should not approve the use of Federal funds for any transportation project which would reduce or eliminate bicycle access.

7. Standards and Guidelines (\$50K)

- The FHWA should insure that the standards for design and construction of bicycle facilities reflect the best, current state-of-the-art.

- FHWA should insure that future revisions to the highway design standards incorporate provisions for bicycles in all appropriate highway designs.
- NHTSA should develop guidelines for bicycle safety program development for use by state and local highway safety officials.
- UMTA should issue guidelines for encouraging bicycle transportation in conjunction with transit improvement projects and programs.

8. Integration of Bicycling into Government Planning Efforts (\$0)

- FHWA/UMTA should require that bicycle provisions be included in the transportation systems management planning process.
- DOT should request all appropriate Federal agencies (DOI, DOE, HUD, EPA) to require full consideration of bicyclists' needs in all Federally funded state and local planning processes.
- The Office of the Secretary of Transportation should undertake a comprehensive policy review of all DOT programs to determine the extent to which bicycle transportation is currently considered and/or affected, and will recommend appropriate revisions.

9. Coordination of Governmental Bicycle Programs (\$0)

- The Department should evaluate with the Consumer Product Safety Commission the possibility of transferring the responsibility for bicycle design standards from CPSC to NHTSA.
- NHTSA, FHWA and UMTA should encourage the establishment of bicycle coordinator positions at the state, regional and local levels and should authorize and encourage the use of Section 402 and other funds for the support of these positions.
- The Department should seek the cooperation of all appropriate Federal agencies in establishing an inter-agency coordinating committee to provide for review of Federal Government activities to promote bicycle transportation, identify new program needs, and recommend processes for monitoring and evaluating current efforts.

10. Increase in Professionals' Acceptance of Bicycle Transportation (300K)
  - FHWA should expand its offerings of the course--Bicycle Considerations in Urban Areas.
  - FHWA should prepare and distribute to professionals an information package outlining the benefits of increased bicycle use.
11. Increase Knowledge of Bicycle Program and Funding Opportunities (\$400K)
  - The Department should issue a comprehensive list of all Federal funding available for bicycling along with eligibility criteria.
  - The Department should periodically publish short summaries of research and demonstration projects, and state and local programs which reflect the best in bicycle transportation state-of-the-art.
  - The Department should provide assistance to Bicycle Forum, a nonprofit journal for bicycle program specialists.
  - The Department should sponsor a National Conference of Bicycle Program Specialists to be held in 1980.
  - NHTSA should consider the need for bicycle-related training programs for highway safety and enforcement personnel.
12. Elimination of Surface and Design Hazards (\$200K)
  - FHWA should emphasize the importance of improvements to the existing street system to provide a safer environment for cycling. These improvements would include widening the outside lane, paving the shoulder, and eliminating specific surface hazards such as oblique angle railroad crossings, potholes, etc.
  - FHWA should encourage the use of the Section 141, Highway Bridge Replacement and Rehabilitation Program, and Resurfacing, Restoration and Rehabilitation (3R) projects for provision of improvements to the existing street system to enhance the safety and use of bicycles.

- FHWA's Office of Highway Safety should work with NHTSA in the development of a jointly sponsored bicyclists' safety standard similar to the joint responsibility that now exists for the pedestrian safety standard.
- FHWA should publish a guide for state and local bicycle facility development which emphasizes the sequential process in the identification and elimination of bicycle hazards. This guide would highlight the desirability of making minor modifications to the existing street system as a top priority with the construction of special bicycle facilities viewed only as a last resort when obstacles or hazards cannot be eliminated in any other way.

13. Improvement of Bicycle Access (\$200K)

- FHWA should develop a manual for use by state and local governments in the identification and elimination of barriers to bicycle access. This guide would emphasize the mobility of bicyclists, the convenience and directness of bicycle routes, and the necessity of providing directional information to bicyclists through signs and maps.
- The provision of bicycle access should be included as a requirement in the Coast Guard Bridge Permit Review process for the construction of bridges over navigable waters.
- The Urban Mass Transit Administration should encourage the provision of bicycle mass transit interface in all Federally funded mass transit programs.

14. Provision of Bicycle Parking (\$0)

- The Federal Highway Administration should develop standards and guidelines specifically for bicycle parking facilities and locking systems. These standards and guidelines will be widely publicized and made available to not only local governments but also private industry.
- The Urban Mass Transit Administration should require the provision of bicycle parking facilities at all new transit stations.



## Other Federal Involvement

There are two levels of Federal involvement that should be examined in relation to the Comprehensive Bicycle Transportation Program. The first consists of actions on the part of all Federal agencies to encourage their employees to bicycle to work. These actions could include improved bicycle parking, showers and lockers for all employees, bicycle fleets for employee use, reimbursement for bicycle mileage on business trips, bicycling education programs available for all employees, and implementation of flexi-time for all employees.

The second level of involvement is confined to those agencies with specific responsibility for programs that directly impact bicycling. These agencies include:

- Environmental Protection Agency--promotion of bicycle transportation as an air quality improvement strategy;
- Department of Energy--promotion of bicycle transportation as an energy conservation measure;
- Department of the Interior--implementation of programs to encourage bicycle use;
- Consumer Product Safety Commission--bicycle design regulation and bicycle safety education for consumers;
- Department of Agriculture--promotion of bicycle transportation through 4-H program; and
- General Services Administration--provision of secure bicycle parking at all Federal installations.

Some specific actions recommended for each of these are as follows:

- Environmental Protection Agency:
  - wide distribution of Bicycling Information Document as a means of alerting state and local officials of possible bicycle strategies;
  - include benefits of bicycling in all air quality improvement promotion programs;

- provide support for training programs to alert bicycle program specialists on the procedures of integrating bicycle programs in air quality planning processes;
  - identify one professional as Bicycle Coordinator to insure full integration of bicycle transportation into EPA programs;
  - join with other Federal agencies in an inter-agency Bicycle Task Force to coordinate all Federal bicycle programs; and
  - train regional staff so they can assist state and local agencies in implementing bicycling strategies for air quality improvement.
- Department of Energy:
    - identify a Bicycle Coordinator to assume responsibility for integrating bicycle transportation into all appropriate DOE programs;
    - include benefits of bicycle transportation in all energy conservation promotion material;
    - join with NHTSA in the development of energy conservation units for driver's education programs to highlight the bicycle as a viable transportation alternative;
    - develop information brochures for industry telling how they can promote bicycle commuting among their employees;
    - participate in training programs for bicycle program specialists on how bicycle transportation can be integrated into energy conservation planning processes;
    - place funding priority on innovative bicycle projects in small-scale appropriate technology grants program;
    - develop media program to promote the bicycle as an energy-efficient mode of transportation, focusing on such aspects as "the gasless vacation;" and

- participate in inter-agency Bicycle Task Force.
- Department of the Interior
  - identify a person to serve as Bicycle Coordinator in the National Park Service and in the Heritage Conservation and Recreation Service;
  - insure that secure bicycle parking is provided at all National Parks, and all other DOI public facilities; parking facilities should be clearly designated by signs and on all maps of facilities;
  - insure that all Department of the Interior facilities are easily accessible by bicycle and highlight this fact (with maps where appropriate) in all promotional materials for the facility;
  - participate in inter-agency Bicycle Task Force; and
  - allow and encourage bicycle rental concessions at all appropriate National Parks and monuments.
- Consumer Product Safety Commission:
  - expand consumer education program relative to safe, efficient use of the bicycle;
  - join in discussions with DOT concerning most appropriate designation of responsibility for bicycle design regulation;
  - examine possibility of developing standards for critical bicycle equipment such as helmets, lighting systems, rear vision devices, locking systems, and carrier systems;
  - identify one person to coordinate CPSC bicycle-related program activities; and
  - participate in inter-agency Bicycle Task Force.
- Department of Agriculture:
  - emphasize benefits of bicycle transportation in ongoing 4-H Bicycle Program;

- contribute to development of a national comprehensive bicycling training program;
  - encourage state and county 4-H programs to implement single recommended bicycling education program rather than wide range of programs of varying quality;
  - conduct training programs for county agents on benefits of bicycling and methods of implementing community bicycle programs;
  - identify individual to serve as national bicycle coordinator for 4-H programs; and
  - participate in inter-agency Bicycle Task Force.
- General Services Administration:
    - actively encourage implementation of new bicycle parking policy at all Federally owned and leased facilities;
    - work with Department of Defense to establish similar policy for military installations;
    - recommend expansion of mileage reimbursement program (for employee business trips) to include trips made by bicycle; and
    - participate in inter-agency Bicycle Task Force.

### C. State Government Involvement

State governments will need to maintain an involvement similar to that of the Federal Government. State organizations will work in partnership with the Federal Government by:

- allocating funds to state and local bicycle programs;
- initiating large-scale statewide programs (curricula development/public information/registration);
- promulgating standards;
- developing statewide transportation, energy conservation, and air quality plans which include bicycle considerations;
- enacting bicycle-related traffic laws;

- designing highway projects to accommodate bicycles;
- encouraging local bicycle program implementation; and
- educating motorists on bicyclists' rights, etc.

Some specific strategies that have been suggested and could be considered by state governments are as follows:

- conduct ongoing public information/awareness campaign to increase awareness and acceptance of bicycle transportation (use wide range of media);
- install signs to inform motorists of bicyclists' right to use roadway;
- adapt driver simulators to depict situations involving road sharing with bicyclists;
- distribute flyers on road sharing techniques to motorists;
- develop media campaign to give positive strokes to motorists who accept bicycles on the roadway;
- develop radio public information campaign to alert motorists of bicyclists' presence on the road;
- include information related to bicycling in driver's ed curricula, behind-the-wheel training, driver's manuals, on licensing exams, and in license and registration renewal applications;
- establish minimum age/competency requirements for all cyclists;
- develop positive image of bicycling through public endorsement by elected officials and celebrities;
- encourage public figures to use bicycles for their own transportation;
- offer on-bike training courses for decision-makers and professionals to alert them to bicycling problems;
- market gasless vacations on bicycle through state tourism program;
- elected officials (Governors, State Senators) should praise cyclists in speeches for their contributions to society;

- bring state vehicle code in line with Uniform Vehicle Code;
- clearly define bicycle's status as vehicle in statutes;
- reimburse state employees for business trips made by bicycle;
- provide free or subsidized bicycle parking at state offices;
- relax work dress codes;
- purchase bicycle fleets for local trips for state business;
- provide showers and lockers for employees who bicycle, walk or jog to work;
- publicize availability of bicycle routes, parking facilities, and inter-modal opportunities;
- establish teacher certification program for all bicyclist training programs;
- include bicycling in physical education programs in high school and college;
- encourage the appointment of bicycle coordinators at the state and local level;
- establish yearly fund for bicycle spot/safety improvement program;
- enact "bottle laws" to eliminate broken glass by edge of roadway;
- develop a manual on bicycle parking guidelines/standards;
- develop/enforce mandatory statewide registration;
- allocate a percentage of gasoline tax revenues for bicycle programs;
- encourage the adoption of state standards for all bicycle design and construction projects;
- establish policy that bicycle access cannot be eliminated or diminished on any state highway project;
- establish locational criteria for bicycle parking facilities;
- establish licensing program for bike mechanics;

- integrate bicycle planning into existing transportation planning process at regional (TIP, TSM, UPWP) and local (urban systems, traffic engineering, public works) level; and
- include landscaping guidelines in all design and locational criteria.

#### D. Local Government Involvement

Local governments continue to be responsible for the majority of activities which directly affect bicyclists and bicycle transportation. These activities will include:

- identifying and planning for the needs of bicyclists,
- enacting and enforcing bicycle-related ordinances (traffic, zoning, etc.),
- improving and maintaining roadways for cyclists,
- constructing/installing bicycle facilities (including bicycle parking), and
- conducting bicycle promotion and education/training programs.

Many of the strategies recommended for state governments (i.e., those affecting state employees, transportation planning, and public endorsements of bicycle transportation) apply as well to local governments. Other possible local strategies which might be considered include:

- designate one individual as City Bicycle Coordinator;
- create a citizen's advisory committee on bicycling to provide input on planning and evaluation of all bicycle programs;
- identify barriers to bicycle access and establish a prioritized schedule of capital improvements;
- focus planning activities on utilitarian rather than recreational routes;
- develop formula for determining index of bicycling route suitability;

- establish local hot-line for bicyclists' complaints, hazard identification;
- clearly define bicycle's status as vehicle in local ordinances;
- develop and implement a comprehensive adult bicyclist education/training program; it should be offered through high schools, colleges, community centers; and continuing education programs;
- establish selective enforcement program against critical bicyclist/motorist violations, advertise program with media campaign;
- develop and impose appropriate strict penalties on adult bicycle violators;
- issue traffic citations to motorists who violate bicyclists' rights;
- establish violator schools for adult cyclists and motorists;
- adopt bicycle parking ordinances for all new public construction;
- provide secure parking at inter-modal links (bus, train, plane);
- install clear signs indicating where bicycle parking is located;
- provide directory of downtown parking facilities--identify and publicize inferior- quality facilities;
- provide stationary maps ("you are here") at key locations of bicycle network (intersection of major bike paths, etc.);
- improve signing around connecting links of bike paths or routes;
- provide destinational signing for separate bicycle facilities and for bike routes;
- publish easy-to-read maps of existing street system and bike paths, detailing bicycle routes, hazardous intersections and hills;
- insure full geographical access through a hierarchy of bicycle feeder and arterial facilities;



- divert auto traffic from heavily bicycle-used secondary streets or recommended bike routes;
- install yield signs instead of stop signs where possible along bicycle routes;
- install signs to alert motorists and bicyclists to bicyclists' right to lane where appropriate;
- ban parking on bicycle routes and on streets with bike lanes;
- reduce weight limit for transit and commercial vehicles along busy bicycle routes;
- install warning signs in advance of bicycle hazards (hazardous intersections, stop signs, etc.);
- modify railroad crossings--rubberized railroad crossing and bridge joints;
- install warning signs in advance of all angled railroad crossings;
- provide curb cuts at all intersections and adjacent to all bike parking facilities;
- install curbside signal activators for bicycle use;
- develop and install bicycle sensitive loop detectors for signal activation;
- install separate signal phase for bicycles at hazardous intersections;
- publicize variety of facilities available to cyclists;
- modify all hazardous sewer grates;
- install separate facilities or links where necessary to breach barriers or avoid hazardous situations;
- design bicycle shortcuts to provide direct route and to encourage safe behavior;
- construct grade-separated crossings at hazardous intersections;
- establish maintenance policy for sweeping, patching, and snow removal for all bike facilities;
- implement roving bicycle patrols along bike paths and equip them to make minor repairs;

- install police call boxes on isolated bicycle paths;
- trim shrubbery and vegetation along bicycle paths;
- police separate facilities with motorcycle patrols;
- construct wind barriers along exposed sections of bicycle paths;
- locate bicycle facilities and routes away from major arterials;
- publish bicycle rental information and provide to tourists at hotels, information booths, etc.;
- require showers and lockers at all public buildings;
- provide coin-op air pumps along remote facilities--include patch kit vending machines;
- publicize friendly gasoline stations in bicycle newspapers and magazines;
- install water fountains, toilet facilities along bicycle paths;
- discourage automobile use through high auto registration fees, restricted auto parking and commuter taxes applying to single passenger auto users only;
- create bicycle-only streets and develop other programs for restricted auto access;
- implement bicycling education programs in all public schools;
- provide bicycle rental facilities at train stations, airports, bus stations.

#### E. Private Sector Involvement

Private sector involvement will range from local bicycle clubs offering cyclists training programs, and private industry providing parking and shower facilities, to professional associations issuing "recommended practices" to their members and the bicycle industry calling greater attention to the bicycle as a transportation vehicle. Some specific strategies follow.

## Bicycle Groups<sup>49</sup>

- Offer mini-clinics at employment centers to introduce novice cyclists to commuter bicycling basics.
- Organize lunchtime presentations on benefits of bicycling.
- Develop audiovisual package to use in speaker programs to introduce groups (Rotary/Kiwanis) to benefits of bicycle transportation.
- Organize bike commuter pools to alleviate anxieties of novice bicyclists.
- Establish policies to endorse high quality bicycle equipment.
- Establish "adopt-a-bikepath" program in which members assume responsibility for a segment of a bikepath.
- Publish directory of retailers and services and distribute to all bicyclists.
- Sponsor maintenance/repair clinics for novice and intermediate cyclists.
- Establish and publicize rules of etiquette for bike paths.
- Encourage YW-YMCA's to allow downtown commuters to shower and change at their facilities (special limited membership).
- Encourage elected officials to include bicyclists' concerns in their platform statements.
- Insure that appointed officials are aware of bicyclists' concerns--as part of their confirmation process.
- Continually work with public institutions in the development of bicycle programs.
- Provide regular briefings on current bicycling issues/developments to public officials.
- Develop a concise information package on social benefits of bicycling--energy, air quality, traffic congestion, and on the estimated levels of use.

---

<sup>49</sup>"Bicycling Groups" refers to national, state and local organizations designed to encourage bicycle use, to represent bicycling interests before government, and/or to provide services directly to bicyclists.

- Publish easy-to-read manuals to introduce novices to bicycling.
- Develop audiovisual package for professionals on needs of bicyclists (hazards, facilities, etc.).
- Encourage life insurance companies to provide discounts on premiums for regular bicycle users (as is done for non-smokers).

### Bicycle Industry<sup>50</sup>

- Market bicycle as mode of transportation rather than recreational vehicle.
- Begin to market a lower profile bike--more utilitarian, less tempting to thieves.
- Sell good locking systems at cost to universities, bike clubs, etc.
- Expand availability of sturdy three-speed bicycles.
- Develop comfortable airless-flatless tires.
- Market lightweight tool kits with directions for use.
- Expand availability of sealed hub, cranks, etc.
- Publicize value of lightweight bicycles.
- Research-improved lighting systems for bicycles--reduce drag of generators or weight of batteries.
- Design adequate rear vision equipment.
- Increase life of bicycle light batteries.
- Research reflective cloth bicyclist's clothes.
- Improve quality of bicycle horns/bells.
- Reduce costs of high quality helmets.
- Establish industry standards for bicycle helmets.
- Improve style of bicycle clothes so they are comfortable and acceptable for work.
- Have a nationwide emergency hot-line for bicycle parts (i.e., call when you are in a small town in need of special part for bike).

<sup>50</sup>Includes retailers and manufacturers.

- Expand availability of upright handlebars.
- Provide wider range of sizes for bicycles--with variations within sizes.
- Improve saddle/seat post/fork design.
- Publicize the value of handlebar padding.
- Market different style bikes for different styles of use (i.e., racing style for racers, maybe tourists, commuter uprights for commuters).
- Involve clothes and industrial designers in design of bike equipment/clothes so that they are less unusual looking, designed for mass audiences.
- Set up cooperative repair shops where people can work on own bicycle under supervision.
- Develop high security locking systems for user and for site.
- Expand marketing of folding bikes for carrying on transit.
- Develop technology for carrying bike on buses and trains.
- Work with insurance companies to provide reasonably priced theft insurance for all bicyclists, not just homeowners.
- Establish bicycle emergency service similar to AAA road service.

#### General Industry

- Provide secure parking facilities at employment centers and downtown locations.
- Introduce flexi-time for all employees.
- Relax dress codes, especially during summer months.
- Industry physical fitness directors should include bicycling as part of program.
- Provide coin-op lockers at all shopping centers for storage of bicyclists' equipment (helmet, pump, etc.).
- Install showers and lockers for all employees.

- Provide model for employees through company management commuting to work by bicycle,
- Reimburse employees for bicycle mileage on business trips.
- Give extra fringe benefits to employees who bike to work, such as extra vacation time.
- Organize bicycle commuting caravans for company employees.
- Designate one employee to serve as coordinator/contact person for all bicycling programs for employees.
- Provide bicycle maps free to all employees.
- Purchase bicycle safety equipment wholesale and sell to employees at reduced rate.
- Purchase a small fleet of bicycles for use on local business errands.
- Offer lunchtime bicycling programs such as bicycle operations workshops, exercise tours, etc.

#### Professional Associations

- Provide training seminars for professionals on bicycle programs.
- Work to include bicyclists' needs in undergraduate and graduate curricula for architects, planners and engineers.
- Include bicycle-related articles or papers in professional journals, symposia, etc.
- Sponsor design competition for best locking/parking system or other design needs.
- Establish certification programs for bicycle professionals.
- Establish regular information dissemination program for bicycle professionals and institutions. This could take the form of a professional journal.
- Issue "recommended practices" concerning integration of bicycle programs into regular professional responsibilities.
- Examine all areas of responsibility to determine potential impact on bicycle transportation.

- Insure that all research papers presented at conferences, etc., include references to bicycle transportation if appropriate (e.g., "Energy Conservation Strategies," "Shoulder Improvements," etc.).

### Media

- Publicize comparisons between auto and bicycle trips in urban areas.
- Run regular features on bicycling in newspapers (e.g., commuting tips, winter bicycling).
- Provide solid media coverage of all bicycling events such as Bike Week, National Bicycle Day, etc., emphasizing benefits of cycling as a transportation mode rather than its peculiarities.
- Develop and sponsor psa's on benefits of bicycling, and on tips for sharing the road with bicyclists.
- Encourage advertisers to run more ads showing people using bicycles for transportation and for recreation.
- Highlight bicycle commuters in special features.
- Publicize which political candidates support bicycling.
- Cover bicycle accidents in news, indicating what happened to the extent possible. Include some bicycle safety reminders.
- Sponsor bicycle activities, such as Bike-a-Thons, Bike-Ins, etc., to call attention to bicycling in the city.

### F. Cost/Benefit Discussion

The underlying question in the stated purpose of this study is, "If everything is done that can be done to promote bicycle transportation, will the energy savings that result warrant the costs involved?" It is the finding of this study that the answer to this question is YES.

Mountain Bicyclists' estimates it will require \$102 million over five years to implement the action plans described in the preceding section. Assuming an investment of an additional \$20 million from other Federal agencies involved, implementation of the Federal Government's role in the

Comprehensive Bicycle Transportation Program would cost \$122 million. Additionally, it is estimated that a comparable commitment from state and local governments would be necessary to carry out their functions in the program. This would bring the total cost of implementing the Comprehensive Bicycle Transportation Program to \$244 million, spread out over five years.

If the goal for the increased use of bicycles for transportation is achieved, the fuel savings in 1985 would be 16.4 million barrels. At \$30 per barrel, this would yield a savings of \$492 million in the first year. The total fuel savings in 1985, if the Comprehensive Bicycle Transportation Program achieves its goal, would be 23.5 million barrels, for an annual savings of \$705 million.

#### G. Summary

This study has determined that the bicycle has not achieved its full potential as a transportation mode. Bicycle use should be promoted and accommodated in order to realize the full benefits of such non-motorized transportation, particularly energy conservation and air quality benefits. We recommend therefore that the Department of Transportation take the lead role in implementing the Comprehensive Bicycle Transportation Program. To carry out this role, the Department should revise its policy on bicycle transportation to provide for:

- the active promotion of the safe, increased use of bicycles for transportation;
- the integration of bicycle transportation into all appropriate Departmental programs and activities; and
- the consideration of bicycle use in all appropriate DOT-funded transportation projects.

The specific actions to be carried out by DOT and other Federal agencies over the next five years focus on the provision of technical assistance and funding to state and local governments for the development and implementation of bicycle transportation projects, and on the establishment of a more affirmative approach to bicycle transportation nationwide.



Other actors in the implementation of the Comprehensive Bicycle Transportation Program are state and local governments, bicycling groups, the bicycle industry, private industry, professional associations, and the media.

It is estimated that the costs for implementing the Comprehensive Bicycle Transportation Program will be \$244 million over five years and that the annual benefits in the form of energy conservation will amount to \$705 million.

In light of this analysis, it is apparent that the bicycle can make a significant contribution to the nation's transportation and energy conservation programs. The investment required to bring the bicycle to its full potential as a transportation mode is small when compared to the long-term benefits which can be realized both by individuals and by the nation as a whole.

APPENDIX A  
SELECTED BIBLIOGRAPHY

## SELECTED BIBLIOGRAPHY

### Articles

- Alexander, Robert. "Bicycling Technology in the Transportation Curriculum," a paper presented at the Eighth National Seminar on the Planning, Design, and Implementation of Bicycle, Pedestrian and Moped Facilities, San Diego, California, July 3-6, 1979.
- Austin, T. C. and Hellman, K. H. "Passenger Fuel Economy as Influenced by Trip Length," paper presented at the Automotive Engineering Congress, Detroit, February 1975; cited in Mayo, M. F., Bicycle Information Document, Draft Report, prepared for EPA, April 1979.
- Baldwin, Leslie. "Federal Funds for Bicycles," Bicycle Forum, No. 2, Fall 1978.
- Bicycle Manufacturer's Association of America. "Some Facts About Today's Bicycle Market," Washington, D. C., 1979.
- Corgel, John B. and Floyd, Charles F. "Toward a New Direction in Bicycle Transportation Policy," Traffic Quarterly, Volume 33, No. 2, April 1979.
- Everett, Michael D. "Commuter Demand for Bicycle Transportation in the United States," Traffic Quarterly, October 1974.
- Floyd, Charles F. "The Future of the Bicycle as a Mode of Transportation in the United States," Traffic Quarterly.
- French, Alexander. "Transportation Energy Considerations," Transportation Engineering Journal, February 1976.
- Hirst, Eric. "Automobile Energy Requirements," Transportation Engineering Journal, November 1974.
- Hirst, Eric. "Energy-Intensiveness of Transportation," Transportation Engineering Journal, February 1973.
- Johnson, Leonard. "Estimating and Forecasting Bicycle Usage," Montgomery County Department of Transportation.
- "A Guide to Bicycle Shopping," Personal Business: A Business Week Supplement.

### Reports

- Barton-Aschman Associates. A Study of Demand Incentives for Non-Motorized Transportation. Washington, D. C.: FHWA, 1979.

- Barton-Aschman Associates. Bicycling in Pennsylvania. Harrisburg: Commonwealth of Pennsylvania, 1976.
- Barton-Aschman Associates. Bicycling in Tennessee. Nashville: State of Tennessee, 1976.
- Bicycling Magazine. Bicycling Subscriber Study. Emmaus, Pennsylvania: Rodale, 1978.
- California Department of Transportation. Planning and Design Criteria for Bikeways in California. Sacramento, California: CALTRANS, 1978.
- Connelly, M. D. and Lofton, E. R. North Carolina Bicycle Registration Study. Chapel Hill, North Carolina: Research Triangle Institute, 1978.
- Corgel, J. B. and Floyd, C. F. The Need for Bicycle Transportation Policy in the U.S. Athens, Georgia: University of Georgia.
- Cross, K. D. Bicycle Safety Education: Facts and Issues. Falls Church, Virginia: AAA Foundation for Traffic Safety, 1978.
- Cross, K. D. and Fisher, G. A Study of Bicycle/Motor Vehicle Accidents: Identification of Problem Types and Countermeasure Approaches. Washington, D. C.: NHTSA (Contract #DOT-HS-4-00982), 1977.
- Cummins, John. Legal Aspects of Bikeway Development with State Motor Vehicle and Fuel Tax Revenues. Washington, D. C.: USER, 1975.
- Davis, B. O., Reed, N. P. and Birnbaum, M. E. Conference Proceedings, Bicycles U.S.A. Washington, D. C.: U.S. Department of Transportation, 1973.
- DeLeuw, Cather and Company. Washington, D. C. Regional Bikeway Study. Washington, D.C.: Council of Governments, 1977.
- Edwards and Kelsey. Manhattan Commuter Bicycle System Study, New York: City, 1975.
- English, J., Conraith, C. and Gallavan, M. Bicycling Laws in the United States. Washington, D. C.: National Committee on Uniform Traffic Laws and Ordinances (Contract #DOT-HS-4-00928), 1974.
- Environmental Protection Agency and the Federal Highway Administration. Joint Strategies for Urban Transportation, Air Quality and Energy Conservation. Washington, D. C.: EPA/FHWA, 1975.
- Gross, J. J., Boyle, D., et al Energy Impacts of Transportation Systems Management Actions in New York State, 1978-1980. New York: NYSDOT, 1979.
- Hirst, Eric. Energy Implications of Several Environmental Quality Strategies. Oak Ridge, Tennessee: Oak Ridge National Laboratory.
- Hirst, Eric. Transportation Energy Conservation: Opportunities and Policy Issues. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

- Hurley, J. L. and Thompson, R. L. Model Programs in Pedestrian and Bicycle Safety for Wisconsin Communities. Madison: Division of Highway Safety Coordination, 1973.
- Jilek, Glenn and Osborne, Richard. Energy Considerations in Transportation Planning. Washington, D. C.: FHWA, 1979.
- Levinson, H. S. Characteristics of Urban Transportation Demand: A Handbook for Transportation Planners. Washington, D.C.: UMTA, 1978.
- MacMillan, E. R. The Denver Bicycle Parking Study. Denver: Mountain Bicyclists' Association, 1980.
- Maryland Citizens Bicycle Study Committee. A Report on the Status of Bicycling in Maryland. Baltimore: Maryland DOT, 1979.
- Mayo, Marda. Bicycling and Air Quality Information Document. Washington, D. C.: EPA (Contract #68-01-4946), 1979.
- McHenry, S. R. Bicycle Parking: A Design Manual. Baltimore: Baltimore County Bikeways Task Force.
- Messer Associates. A Study of the Health Effects of Bicycling in an Urban Atmosphere. Washington, D. C.: USDOT (Contract #DOT-OS-70022), 1977.
- Moore, M. C. An Investigation of the Potential Use of Bicycles in the Total Transportation System. Sacramento: CALTRANS, 1974.
- Moran, K. National Bicyclist Training Program; Feasibility Study. Washington, D. C.: Bicycle Federation, 1979.
- Office of Technology Assessment. Technology Assessment of Changes in the Future Use and Characteristics of the Automobile Transportation System. Washington, D. C.: OTA.
- Organization for Economic Cooperation and Development. Safety of Two-Wheelers. Paris: OECD Road Research Group, 1978.
- Planning/Architecture/Environmental Design. Bicycle Commuting in the San Diego Region. San Diego: Comprehensive Planning Organization of the San Diego Region, 1977.
- Reed, M. F. The Economic Cost of Commuting. Washington, D. C.: Highway Users Federation, 1975.
- Sanders, D. B., Reynen, T. A. and Bhatt, K. Characteristics of Urban Transportation Systems: A Handbook for Transportation Planners. Washington, D. C.: UMTA, 1974.
- Seamans, R. C. A National Plan for Energy Research, Development and Demonstration: Creating Energy Choices for the Future. Washington, D. C.: ERDA, 1979.

- Suhrbier, H. J. and Deakin, E. A., et al. Implementation and Administration of Air Quality Transportation Controls: An Analysis of the Denver, Colorado Area. Washington, D. C.: USDOT, 1978.
- Tjart, Arlene. A Look at Changing Transportation Behavior. (Unpublished Master's Thesis, University of Colorado) Denver: 1980.
- Transportation Task Force. Institutional Framework for Integrated Transportation Planning. Washington, D. C.: Urban Consortium for Technology Initiatives, 1978.
- Transportation Research Board. Environmental and Conservation Concerns in Transportation: Energy, Noise and Air Quality. Washington, D. C.: TRB, 1977.
- U. S. Department of Transportation. Energy Conservation in Transportation. Washington, D. C.: USDOT, 1979.
- U. S. Department of Transportation. Energy Impact Analyses Resource Information. Washington, D. C.: FHWA, 1976.
- U. S. Department of Transportation. 1979 Transportation Systems Management Elements for the San Diego Region. Washington, D. C.: USDOT, 1979.
- U. S. Department of Transportation. Operating Multi-Modal Urban Transportation Systems. Washington, D. C.: USDOT, 1977.
- Victorian Government. Geelong Bikeplan. Victoria, Australia: 1972.
- Wagner, F. A. and Gilbert, K. Transportation System Management: An Assessment of Impacts. Washington, D. C.: FHWA and EPA, 1978.
- Williams, J. E. and Moran, K. (Eds.) Community Bicycle Programs: Draft Report. Washington, D. C.: Bicycle Federation, 1979.
- Williams, Robert. "Bicycles and Energy," in Cyclateral Thinking. Washington, D. C.: USER, 1976.

APPENDIX B  
IDENTIFIED RESEARCH NEEDS

## IDENTIFIED RESEARCH NEEDS

In order to successfully implement and evaluate the comprehensive program described in this report, it will be necessary to implement a parallel research program to be carried out by various agencies of the Federal Government and by state and local agencies. This is not to suggest, however, that implementation of a comprehensive program should be delayed until research is completed. Because of the urgency of the present energy situation, it is advisable to proceed with those program elements which can be implemented now without the need of further research. Then, once the research programs identified below have been completed, their results can be used as input to further development of the comprehensive program.

The research recommendations presented below have been organized according to the four major sub-objectives identified for the Comprehensive Bicycle Transportation Program--that is, to increase operator competence and awareness; to improve the transportation infrastructure; and to increase institutional and professional responsiveness. The specific agency or agencies responsible for the conduct of this research have not been identified since, in many cases, the research could be conducted by the Federal Government, by private sector organizations, or by various agencies of state and local government. Inclusion of a research project in this listing should not be construed as a commitment by the Department to sponsor that project; rather it indicates a strong endorsement of the need of such research.

### Increase Operator Competence and Awareness

- Develop bicycle operator task analysis. Currently there does not exist any systematic analysis of what is involved in bicycle operation since it is viewed by many as an almost innate skill developed in childhood. This project would be designed to identify the specific tasks required in the operation of the bicycle and to determine the criticality of those tasks related to safe and efficient operation. This task analysis would then be used as the basis for the development of a comprehensive bicycle-operator training program.
- Assess the feasibility and effectiveness of a bicycle operator licensing program. Licensing of the bicycle operator has been viewed by many as the essential factor in improving the status of bicycling as a mode of transportation. Licensing, however, does not appear to be very feasible because of the severe restrictions it would place on the use of the bicycle by young children, and because of the difficulties involved in the development, implementation, and enforcement of such a program. It would be appropriate to examine the concept further, particularly with regard to its feasibility aspects and to its effectiveness in reducing bicycle accidents and improving the social image or acceptability of bicycle transportation. A demonstration program in one or more local communities would probably be the most successful method of carrying out this type of research.



- Demonstration and evaluation of a variety of enforcement techniques and campaigns. The widespread violation of the law by bicyclists, and the general lack of enforcement of these laws have been instrumental in the development of a negative image for bicycle users. A critical element in the modification of this image is the elimination of violations through enforcement and education programs. The purpose of this project is to identify several apparently successful approaches for dealing with bicyclists' violations, documenting the nature of the techniques used, and evaluating their effectiveness. The results of this research project should then be published in a condensed format and distributed widely to local police jurisdictions.
  
- Identification of non-motor vehicle-related bicycle accident types. While the National Highway Traffic Safety Administration has conducted extensive research into the causes of accidents involving bicycles and motor vehicles, there has been no national effort to identify the factors involved in non-motor vehicle-related bicycle accidents. While these types of accidents are generally much less severe than accidents involving motor vehicles, they do account for the vast majority of accidents in which bicyclists are involved. Information on the nature and causes of these accidents needs to be gathered either on a national basis or by several communities around the country using a common methodology.
  
- Identification of user characteristics. This study on the energy conservation potential of bicycle transportation has examined the current levels of bicycle use in the United States. The data available for the study, however, are rather limited and do not provide information on several key aspects of bicycle use. In order to provide a solid data base on current levels of use for evaluating progress in the implementation of this comprehensive program, a large variety of data on bicycling in the United States should be collected. These data could be included in ongoing national survey programs so that they can be updated regularly. The surveys should focus on the age, sex, and income of bicycle riders, particularly those who use their bicycles for transportation; the various types of bicycle trip purposes and the average trip length for these purposes; the effects of such factors as weather, climate, and terrain on the choice of the bicycle over other modes; the relationship of city size to volume of bicycle travel; the frequency at which a bicycle is used on a daily, weekly or monthly basis; seasonal variations in bicycle use; the accident experience of those who ride bicycles regularly; the mode which the bicycle replaces on regular commuting or personal business trips; the degree of satisfaction that is experienced with the bicycle as a mode of transportation; the average duration of a bicycle trip; and the maximum time willingly allocated to any particular bicycle trips; the number of autos owned by people who ride bicycles; and finally, the principal obstacles and disincentives that various individuals encounter on their regular bicycle trips. In addition to the actual collection of this type of data, it would also be valuable for a simple methodology to be developed that could be used by local governments for the collection of similar data to guide them in their planning and design efforts on behalf of bicyclists.

- Comparison of the effectiveness of classroom versus on-bike training in the development of skills and the modification of attitudes and behavior. On-bicycle training has been viewed over the last several years as an essential element of any bicyclists education program. There have been identified, however, many problems and risks associated with on-bike training which serve as obstacles to local program developers. There have been some who have theorized that the use of high-quality audio-visual materials will provide the information necessary to train cyclists in hazard recognition and avoidance without the risks associated with actual on-bike experience in traffic. Since there are so many objections to on-bike training programs, it would be advisable to compare the effectiveness of on-bike training to a classroom-only approach to determine if there are any significant gains to be realized from the on-bike experience.

### Improvement of the Transportation Infrastructure

- Development of a road safety index. Despite the volume of work that has been done in the planning and design of bicycle facilities, there has been no effort made to identify the factors that make an existing street safe or unsafe for bicycling. What would be involved in this project is the identification of the critical factors, the determination of their relative importance, and the establishment of thresholds for the evaluation of bicycle safety for each of those factors. These factors would include such items as lane width, number of lanes, traffic volume, traffic speed, presence and condition of shoulder, sight distance, surface conditions, number of intersections, land use, lighting, etc. This project would attempt to organize these factors into a series of criteria for use by local planning officials in judging the suitability of any particular road for bicycle travel. The project should attempt to establish several different levels or degrees of safety for any particular road, reflecting the varying degrees of experience that bicyclists possess. In other words, a particular road could be graded as safe for experienced cyclists, demanding for a cyclist with moderate experience and unsafe for children and novice cyclists.
- Identification of specific hazards to bicyclists at intersections. It has been identified that the majority of serious bicycle accidents occur at or near intersections. While the intersection problem has been well acknowledged, there has not been much work done to identify the relationship between accidents and intersection design or to develop strategies to modify intersections for the safer accommodation of bicycle travel. The results of this project would be distributed widely in the form of guidelines to state and local planning officials for their use in the modification of the existing street system.
- Identification of trip characteristics of various types of bicycle riders. There is generally acknowledged to be several classes of bicycle users, each with different levels of skills, trip purposes, and demands in terms of bicycle facilities. There has, however, been no documentation of the percentage of the bicycling population that falls into the various cate-

gories; whether or not a person starts on one category and eventually moves to another or stays in the original category; and the relationship of these various categories and trip purposes to facility design and street modifications. This project would attempt to investigate the various trip characteristics that differentiate classes of bicyclists in terms of their facility needs, and to identify the exposure rates for these different classes of bicyclists. Once the relative needs for different facilities have been identified for the various users, a series of guidelines can be developed for the allocation of resources between separate facilities and shared facilities.

- Hazard analysis of bicycle facilities--shared and separate. The conditions bicyclists face, whether on a city street or on a bicycle path, have a great deal to do with their enjoyment and acceptance of bicycling as a mode of transportation. The bicyclists' perception of safety, however, may or may not reflect what really is safe or dangerous on a particular facility. It is necessary to conduct research into the various hazards bicyclists encounter and the effect of those hazards on their overall safety. Particular attention should be paid to identifying the causes of non-motor vehicle-related accidents since it is this type of accident that is the most likely to be caused by surface hazards, visibility problems, lack of clearance, etc., particularly on separate facilities. Once these hazards have been identified, the work should continue on to develop design solutions for these problems, to be included in warrants for the design of separate and shared facilities.
- Evaluation of the safety effect of bicyclists' use of interstate shoulders. The majority of states ban bicyclists from the use of any portion of the interstate system. The State of California, which allows bicycles along certain segments of the interstate system, has conducted an analysis of the use by bicyclists of interstate shoulders and determined that there is no major safety problem associated with it. This type of research needs to be conducted in other portions of the country to serve as documentation for the acceptability and even value of allowing bicyclists to use the shoulder of the interstate, particularly when there is no safe alternate route available.
- Demonstration of feasibility of carrying bicycles on mass transit vehicles. There have been several projects, particularly in California, in which bicycles have been accommodated on the back or in the luggage compartment of transit vehicles along specific routes or at certain hours. Success of these projects appears to vary greatly from place to place, and is perhaps a function of the degree of difficulty encountered in the implementation of the program. This project will consist of a controlled demonstration and evaluation of this type of multi-modal use with the purpose of providing guidance to local communities which are considering it as an option for expanding the use of bicycles and transit vehicles.
- The evaluation of the effectiveness of bicycle registration programs. Bicycle registration is claimed to be a major deterrent to bicycle theft and an aid to the recovery of stolen vehicles. There has, however, never been an evaluation of its performance in these areas. This project would

consist of the evaluation of the different types of registration programs (i.e., local voluntary programs, local mandatory programs, local mandatory programs in conjunction with several other communities, and finally, a mandatory statewide program), and their impact on theft of bicycles within the communities studied as compared to other communities of similar size and demographics, and on the recovery rate of bicycles within the community as compared with other communities and the national average. If registration does prove to be effective in either reducing the threat of theft or in improving the recovery rate for stolen bicycles, then the project would conclude with the development of guidelines as to which type of program is most effective and how it can be implemented.

- Evaluation of various types of bicycle parking systems. There is a wide range of bicycle parking systems now available to communities. However, they vary widely in their ability to provide security to the bicycle and its parts. As a result, thousands of dollars are wasted in the purchase of totally inadequate systems. Since it is clear that there are certain types of systems which are unacceptable to bicyclists, standards should be established for the use of Federal funds for the purchase of bicycle parking facilities to insure that they provide at least minimum security. Tests should be conducted to determine the performance of all of the systems currently available to establish thresholds for minimally acceptable performance.
- Evaluation of the safety effect of separate bicycle facilities. There has been a tremendous amount of controversy in recent years over the value of separate facilities for improving the safety of cyclists. However, there has been no organized, rigorous evaluation of the impact of separate bicycle facilities on the incidence of bicycling accidents (bike/motor vehicle, bike/ped, bike/bike, and bike only). The purpose of this project would be to determine relative exposure measures for bicyclists on shared facilities and for bicyclists on separate facilities, and to establish an accident rate for the two types of facilities. Accident severity should also be examined and compared.
- Comparison of the effects on safety and mobility of bicycle lanes versus curb lanes. The purpose of bicycle lanes is to provide an environment for bicycling on the existing street system that is separated somewhat from the regular stream of traffic, thus increasing the perceived safety of the bicyclist. There has been speculation, however, that the bicycle lane does no more to increase safety or to improve mobility than the regular widening of the curb lane, and in fact, may reduce safety because of the turning conflicts created. A comparison should be made in communities in which both bicycle lanes and wide curb lanes are available to determine the effect that either installation has on the actual safety of the bicyclist. Particular attention should be paid to accidents occurring at intersections both on streets with widened curb lanes and on streets with bike lanes.

- Determination of the effect of bicycle/mass transit interface opportunities on the volume of mass transit ridership. One of the most promising aspects of promoting bicycle transportation appears to be the opportunity it provides for improved multi-modal use of mass transit facilities. However, this assumption is based on pure speculation that the opportunity to combine bicycle and mass transit for the trip to work will result in an increase in the ridership of both modes. An analysis should be made of the before and after effects of providing the opportunity to carry bicycles on mass transit vehicles along certain routes, or during certain hours of the day. Since both of these strategies involve some significant capital expenditures, it would be advisable to determine the feasibility and effectiveness of such strategies before they were encouraged or required on a national basis.

### Increase Institutional Responsiveness

- Comparison of cost-effectiveness of expenditures to promote bicycle transportation versus expenditures for other surface transportation modes. The bicycle has traditionally been one of the lowest priority items in government funding agendas. The justification of this has been that bicycling is a form of recreation and is not serious transportation. Information gathered in this report and in other recent studies indicates that the bicycle is in fact an extremely energy-efficient form of transportation which can also provide social benefits in the forms of improved air quality and physical fitness. The purpose of this study would be to gather the more accurate estimates of the effect of bicycle transportation on energy conservation, and to develop specific cost estimates for implementation of a comprehensive bicycle transportation program at the community level. Using these new, more realistic assessments of the cost-effectiveness of bicycle transportation, this project would compare bicycle transportation to the cost-effectiveness of other energy conservation strategies. Funding allocations for bicycle programs should be compared with those for other energy conservation measures.
- Case study analyses of various approaches to bicycle program development and implementation. There has been a great deal of demand in recent years for documentation of "success stories" in the development of comprehensive bicycle transportation programs. The difficulty encountered in development of these success stories is that the prime motivation for the development of a program has been the initiative of a single individual or group of individuals within a community. These types of situations have not been transferrable to other communities. Over the past year or more, there have been significant increases in the number of people who are dedicated to the improvement of conditions to promote bicycling in the United States. As a result, the problem of identifying key individuals has been significantly reduced. Therefore, it is now appropriate to examine the wide variety of approaches that are being taken at the state and local level and to identify the critical elements of these program approaches. The purpose of this project would be to provide a range of choices to a given community considering the initiation

of a comprehensive bicycle transportation program. This range of approaches would reflect varying levels of effort and varying degrees of financial support required. It would also be desirable to relate these levels of effort to expected results in terms of increased safety and increased volume of ridership.

- Review of the current state-of-the-art of program development and implementation at the state and local level. In 1974, the National Highway Traffic Safety Administration conducted a study of pedestrian and bicycle safety programs throughout the United States. This study was required by Section 214 of the Highway Safety Act of 1973. Its primary finding was that there was a very low level of effort accorded to promote bicycling safety both at the state and local level. The primary reason for this low level of effort was the low priority accorded bicycle safety, the low volume of funds made available to it, and the general lack of awareness of what was essential to increase bicycle safety within the entire population. Since that time, there has been significant attention paid to the problems of bicycle safety and bicycle transportation and what is needed to promote both areas. There has not, however, been a significant review of what progress has been made in these areas by the state and local government. It would be desirable at this time to determine the effects of such activities as the 214 study itself, the Bicycle Safety Education Conference held by NHTSA, and the Regional Bicycle Safety Workshop sponsored by NHTSA, and by the activities of both the Office of the Secretary of Transportation and the Environmental Protection Agency to encourage bicycle transportation strategies as a means of improving the overall transportation, energy conservation and air quality systems within the United States. In those areas where no apparent progress has been made, it would be important to identify the reasons given by state and local officials for their lack of interest or attention paid to bicycle transportation.

