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REPORT NO. DOT-TSC-OST-77-69

WORKSHOPS ON TRANSPORTATION-AIR QUALITY RESEARCH NEEDS FOR STATE, REGIONAL, AND LOCAL GOVERNMENT OFFICIALS

U.S. Department of Transportation
Transportation Systems Center
Kendall Square
Cambridge MA 02142

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DECEMBER 1977

FINAL REPORT

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Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF THE SECRETARY
Office of the Assistant Secretary for
Environment, Safety, and Consumer Affairs
Office of the Assistant Secretary for Systems
Development and Technology
Office of Systems Engineering
Washington DC 20590

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT-TSC-OST-77-69		

4. Title and Subtitle	5. Report Date
WORKSHOPS ON TRANSPORTATION-AIR QUALITY RESEARCH NEEDS FOR STATE, REGIONAL, AND LOCAL GOVERNMENT OFFICIALS	December 1977
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No. DOT-TSC-OST-77-69
9. Performing Organization Name and Address U.S. Department of Transportation Transportation Systems Center Kendall Square Cambridge MA 02142	10. Work Unit No. (TRAIS) OS822/R8511
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address U.S. Department of Transportation Office of the Secretary Office of the Assistant Secretary for Environment Safety and Consumer Affairs Office of the Assistant Secretary for Systems Development and Technology Office of Systems Engineering Washington DC 20590	13. Type of Report and Period Covered Final Report April 1977-July 1977
	14. Sponsoring Agency Code

16. Abstract

Four workshops on transportation-air quality research needs were sponsored in the Spring of 1977 by the U.S. Department of Transportation (USDOT) to identify the requirements for a research and development program. One hundred and sixty six persons attended the workshops, representing leaders in the transportation and air quality fields from local, regional, and State and Federal governments. Based on the workshops, and the collected analysis of distinguished transportation-air quality practioners subsequent to the workshops, a report was prepared that first documents the ten most urgent transportation-air quality issues and then recommends sixteen research programs to address these issues.

17. Key Words	18. Distribution Statement
Air Quality Air Pollution Transportation Planning	DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	114	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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PREFACE

Between April and July 1977, the U.S. Department of Transportation (USDOT) sponsored four workshops. The purposes of these workshops were to identify and define the research, technological, and institutional needs related to transportation sources of air pollution.

The opinions, conclusions and recommendations expressed in this report are those of the attendees who were representatives of their respective transportation and air quality agencies of state, regional, and local governments.

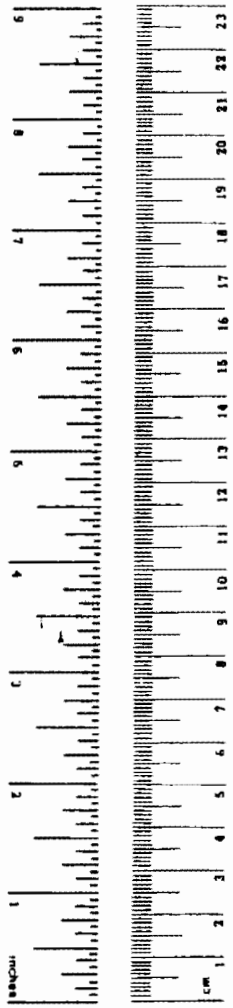
The New England Municipal Center, Under subcontract to the Raytheon Service Company, assisted US DOT in planning and conducting the workshops and in the preparation of this report of findings. In addition, US DOT gratefully acknowledges the significant contributions of Fedele Palmieri, Associate Transportation-Environmental Specialist, New York State Department of Transportation and Earl Shirley, Transportation Laboratory. California State Department of Transportation. Thanks are also due to David Knapton, Raytheon Service Company, the group discussion leaders, session moderators and other participants who contributed their time and effort to the success of the workshops.

Samuel C. Coroniti, Project Director, TST-46
Dr. Fred F. Marmo, Senior Project Engineer, DTS-331
U.S. Department of Transportation
Washington, D.C.
January, 1978

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.96	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
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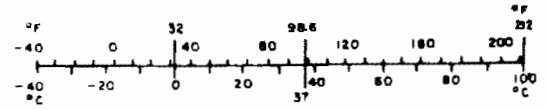

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Final Report

EXECUTIVE SUMMARY

Four workshops on transportation-air quality research needs were sponsored in the Spring of 1977 by the U.S. Department of Transportation (USDOT) to identify requirements for research and development. One hundred and sixty six persons attended the workshops, representing leaders in the transportation and air quality fields from local, regional, and State and Federal governments. Based on the workshops, and the collected analysis of distinguished transportation-air quality practitioners subsequent to the workshops, a report was prepared that first documents the ten most urgent transportation-air quality issues and then recommends sixteen research programs to address these issues.

Workshop Design and Participants

The one-day workshops were conducted in Cambridge, Massachusetts; Atlanta, Georgia; Kansas City, Missouri; and San Francisco, California. In the morning, participants divided into small group discussions to examine the most serious problems affecting the following areas: project analysis, systems analysis, and alternative policy decisions. Following lunch, the small group discussion leaders reported on their group's findings to the full meeting. The workshops were designed for maximum non-Federal participant involvement. The Federal officials in attendance participated primarily as observers. Workshop attendees represented over 40 states, 18 urban areas, 20 MPOs and USDOT headquarters and modal agencies; regional USDOT and USEPA officals also attended.

Procedure Used for Workshop Data Analyses

Following each workshop, a summary report was prepared and distributed to workshop discussion leaders for their review and comment. The transcript of each workshop was also examined in preparing the summaries. The summaries were the basic background material used, in addition to the transcripts, to prepare the final report of the workshops.

Final Report Content

The final report is in three parts. Part I is an introduction which reviews the background of the workshops, participant characteristics, and scope of the report.

Part II describes the rationale and procedures used for analyzing workshop data. The ten most important transportation-air quality issues requiring research and development efforts are defined and ranked as follows.

(1) Air Quality Modeling
(2) Integration and Coordination of Interacting Federal Programs
(3) Mobile Emission Factors
(4) Education of the Public
(5) Interagency Cooperation
(6) Transportation Control Assessment
(7) Transportation Modeling
(8) Study Planning and Analysis
(9) Aerometric Monitoring
(10) Integrated and Comprehensive Analysis.

For each issue, the final report comments on its content, scope, and ranking.

In Part III, the set of issues provides the framework for formulating, selecting, and recommending two types of research:

(1) Program-related research having applicability to the three workshop-related categories - systems analysis, project analysis, and policy alternatives; and
(2) Task-related research which has its principle applicability to only one of these three categories.

The research recommendations discussed in the final report are listed below by type and title.

1. Systems Analysis, Project Analysis, and Policy Alternatives: Program-Related Research Recommendations

   1.a. General Air Quality Modeling
   2.b. Identification and Coordination of Issues

2. Systems Analysis: Task-Related Research Recommendations

   2.a. Improvement of System Air Quality Models
   2.b. Calibration and Validation of Models
   2.c. Improve Consistency Assessment Process
   2.d. Public Information/Education
   2.e. Evaluation of Transportation Control Strategies
   2.f. Improvements in Necessary Transportation Modeling Methodology, and Coordination with Air Quality Modeling

3. Project Analysis: Task-Related Research Recommendations

   3.a. Improve Microscale Pollutant Dispersion Models
   3.b. Improve Information Dissemination Through Interagency Cooperation/Coordination
   3.c. Improved Specifications for Study Planning and Analysis
   3.d. Improved Methods and Procedures for Aerometric Monitoring
   3.e. Improved Mobile-Source Emission Factors

4. Policy Alternatives: Task-Related Research Recommendations

   4.a. Develop New Methodologies for Integrated and Comprehensive Analysis
   4.b. Integration and Coordination of Goals and Policies
   4.c. Public Education on Transportation Policy

A perusal of this list shows that no attempt was made to limit research recommendations to purely technical areas; indeed, most of the important problems perceived by the user agencies were of a policy or other non-technical nature. Each research recommendation contains the following information:

(1) A statement of the technical nature of the problem;

(2) A set of specific, achievable objectives for research contributing to the solution of the problem;

(3) A research and steering review committee to assist USDOT ensure the usability of the work to be undertaken; and

(4) A specification of the desired product(s) of the research effort.

This format was adopted to provide USDOT with an information base designed to assist in formulating, planning, and implementing any future research and development programs.

WORKSHOPS ON TRANSPORTATION-AIR QUALITY RESEARCH NEEDS FOR STATE, REGIONAL AND LOCAL GOVERNMENT OFFICIALS

PART I. INTRODUCTION

A series of workshops on transportation-air quality research needs were cosponsored by the U.S. Department of Transportation's Office of the Assistant Secretary for Environment, Safety, and Consumer Affairs and the Office of the Assistant Secretary for Systems Development and Technology from April to June, 1977. Four one-day workshops were conducted in Cambridge, Massachusetts; Atlanta, Georgia; Kansas City, Missouri; and San Francisco, California. A selected group of regional, state, and local government transportation and environmental-protection officials were invited to participate at each workshop. One hundred and sixty six persons attended the workshops, including 70 state government representatives, 49 local government officials, and 47 Federal agency officials.

Purpose

The purpose of the workshops was to provide assistance to USDOT in identifying the requirements for research and development in the area of transportation system and facility impacts on air pollution. This information was intended to assist in the formulation and management of the DOT research and development program. Specific workshop objectives included: (1) identification and explicit definition of the problems faced by participants related to the impact of their transportation policies and programs on air quality; (2) prioritization of these problems; and (3) determination of what technical assistance could be rendered by DOT through its R & D programs to assist the participants in addressing the identified problems.

Workshop Methodology

Small group sessions were conducted during the morning of each workshop, followed by two general sessions in the afternoon. The small group discussions

were divided into three areas representing state, local and regional government officials' interests: systems analysis, project analysis, and alternative policy decisions. Discussion leaders assisted each small group to review problems related to their specific area of concern and expound them to the entire group in the afternoon.

Workshop Participants

The workshops were designed and conducted for maximum non-Federal participant involvement. The Federal officials in attendance participated primarily as observers; occasionally they assisted by clarifying problems and issues. Workshop participants were selected jointly by USDOT, state DOTs, and the New England Municipal Center, which had the contractual responsibility to conduct the workshops. Persons were invited to attend who had previously expressed interest in transportation-air quality problems, who had technical and administrative responsibilities for complying with USDOT /USEPA air quality requirements, and who were recognized by their colleagues as leaders in the field.

This report is based primarily on the perceptions, observations, and recommendations of the non-Federal persons who attended the four workshops. The chart below outlines the number of persons who attended from different agencies. This profile of the participants will assist the reader to determine the credibility of this report. Over 40 states, 18 urban areas and 20 of the country's largest Metropolitan Planning Organizations (MPOs) were represented at the four workshops, in addition to DOT's modal agencies and regional DOT and U.S. Environmental Protection Agency officials.

PARTICIPANTS AT TRANSPORTATION-AIR QUALITY RESEARCH NEEDS WORSHOPS

Type/Workshop	Northeast	Southeast	Central	West	Total
State - DOTs	11	11	8	9	39
State - EPAs	7	6	2	5	20
State - Other	2	2	2	5	11
Total State	20	19	12	19	70
Local - City/County	4	3	6	5	18
Local - MPOs/APCs	5	3	6	8	22
Local - Trans. Auth.	4	1	2	2	9
Total Local	13	7	14	15	49
Federal - DOT	4	6	6	12	28
Federal - EPA	5	3	7	4	19
Total Federal	9	9	13	16	47
TOTAL	42	35	39	50	166

Report Contents

This report documents and expands on the issues discussed at the four workshops (see Appendix A) by the participants (see Appendix B). At each workshop, all discussion and seminar proceedings were recorded. The transcripts were used in preparation of this report. Additionally, consideration was given to separate reports of persons actually attending the meetings. Part II presents discussions of the ten most urgent transportation/air quality issues identified through the workshops as being of national concern. These issues were then ranked by a method which bases its selections upon a consensus of the opinions of the participants. The ten issues define the scope and nature of the most urgent needs of regional, state and local transportation officials. Part III recommends a specific program of actions which USDOT may take to implement a transportation-air quality R & D program which responds to these issues. Appendices include details of the individual workshop discussions and lists the addresses of participants. Full transcripts of the workshop sessions are available separately for the cost of reproduction.

PART II: NATIONAL ISSUES FOR TRANSPORTATION-AIR QUALITY RESEARCH

Contents

PART II:

NATIONAL ISSUES FOR TRANSPORTATION-AIR QUALITY RESEARCH

Introduction

A review of the problems and assistance needs expressed by the workshop participants reveals a pattern of universal concern regarding some of the key issues. These points recurred, sometimes in surprisingly similar expressions, in many or all of the workshop summaries, and can safely be taken to be those issues on which a national consensus exists as to their importance.

Selection and ranking of these issues required careful and analytic consideration of the frequency and intensity of their discussion at workshop sessions, and some initial judgements regarding the combination and categorization of similar, or unclearly articulated, problem statements. A methodology was developed to analyze the frequency of appearance and discussion of the ten summary categories finally arrived at. Application of a methodology* developed and applied by E. Shirley, California State Department of Transportation, generated the list and ranking of issues.

In addition to the above analytic approach, one other strategy was utilized to establish the relative importance of issue areas. Draft statements summarizing individual workshop proceedings were distributed to workshop discussion leaders for their review and comment; feedback from these participants was used to refine and focus the four workshop problem statements. Also, drafts of this entire section (Part II) were also distributed to distinguished transportation-air quality leaders across the country for their input; their suggestions are also incorporated into this final statement.

Below are described the ten categories of priority issues as identified by the workshop participants, with some commentary intended to indicate their relative importance to the various regional workshops. The problems are listed in the final order of ranking.

(1) Air Quality Modeling (AQM)

This includes the entire process of mathematical modeling of transportation-air quality impacts, beginning with model development and continuing through

*For a detailed description, contact E. Shirley at address given on page B-17.

validation, implementation, and use of the results. This was a "generic" problem, that generated expressions of concern throughout the System, Project, and Policy subgroups of the four workshops.

This category received heavy emphasis in all four workshops, both in problem statements and discussions of research needs. Greatest concern was placed on this category in Atlanta, but it was extensively discussed at all four workshops.

In the Systems sessions, problem statements concerned model specificity, development, funding of development, simplicity vs. complexity, relationship to decision making, validity of inputs, validity of the resultant models and the concept of their use, and analysis of outputs.

The Project sessions expressed concern over model availability, accuracy, applicability to special situations, calibration, funding requirements, and the ability of models to produce accurate forecasts for certain pollutants.

Research needs, discussed in detail in Part III included a state-of-the-art evaluation of models, methodology for customizing models for special situations and pollutants, and further refinement of models.

(2) Integration and Coordination of Interacting Federal Programs (ICP)

Emphasis here was on the relationships among separately funded and administered Federal programs in the areas of environmental protection, transportation, and energy. As might be expected, this category received extensive discussion in System and Policy sessions. This category did not receive extensive discussion at Project sessions during the workshops, but the emphasis which had to be placed on topic (3) below subsequent to the workshops is a dramatic illustration of how important interagency coordination can become to Project considerations. Overlap with category (4) below, Interagency Cooperation, is important and the boundaries of the two subject areas are difficult to define. If the two categories were combined, and this is feasible, the resulting category would rank number one.

The range of specific problems related to this topic was large, and is discussed in Part III below. Analysis of the original problem statements

as summarized in Appendix A reveals a substantial sense of frustration at both state and local levels over a perceived management failure at the highest Federal levels to coordinate conflicting programs and priorities which impact severely upon the transportation function.

(3) Mobile Emission Factors (MEF)

This refers to the availability and use of mathematical factors which relate the rate of pollutant emissions to vehicle operating parameters, such as speed and distance traveled.

The problems identified involved the representativeness and validity of emission factors supplied to transportation planners by the U.S. Environmental Protection Agency (USEPA). Workshop participants called for a review of emission factor development, a more orderly update schedule, and development of new factors for special situations.

Recently, problems have arisen over the selection of the latest ("Supplement 8") USEPA factors*, with disagreements between USEPA and USDOT currently taking place over the validity and applicability of the factors. The reasons for concern over this situation are described in more detail in Part II.

(4) Education of the Public (EOP)

This refers to the creation of a changed awareness among the general public of the various interactions, trade-offs, and consequences of attempts to improve air quality via changes in transportation systems.

Problems in the Systems sessions concerned public confusion with timetables and pollution-control strategies. Concern was also expressed over public lack of awareness of program objectives, health effects, and the magnitude of the problem. Perhaps significantly, these problems were largely articulated by workshop participants from environmental-protection type agencies.

*Contained in Supplement 8 to Compilation of Air Pollutant Emission Factors, AP-42; April, 1973.

Policy sessions were more concerned with maximizing public acceptance of the measures required to control air pollution, especially those which were disincentives or required changes in life style. Such concerns were particularly articulated by participants involved in transportation system planning and decision making.

(5) Interagency Cooperation (IAC)

Emphasis in this category is on the interrelationships of Federal, state, and local agencies responsible for portions of the air quality and transportation programs.

The appearance of this category was rather scattered. It was present at all four workshops in various sessions; no pattern existed to indicate that it applied particularly to System, Project or Policy work. As was indicated under the Issue 2 discussion (Integration and Coordination of Federal Programs), many concerns are shared between the two categories. Their thrust, however, is different: in ICP, attention is focused on program policies and goals, while here, the concern is on operational and personnel-related problems such as uncooperativeness, reluctance to communicate, and confusion among agency personnel regarding roles of their agency and other agencies.

(6) Transportation Control Assessment (TCA)

This category refers to the development, application, and evaluation of various "Transportation Control Plans" (TCP) and specific strategies for the control of vehicular-related air pollutants.

This category appeared in all four workshops; as might be expected, discussion was confined to the Systems sessions.

The concerns expressed in the sessions involved: the applicability of TSM (Transportation System Management) elements developed under the ongoing FHWA (Federal Highway Administration) transportation planning process to control strategy development; sensitivity of control strategies to vehicle miles travelled (VMT); the difficulty of estimating control strategy

impacts; and the "real world" socioeconomic and political considerations and effects associated with implementation of transportation controls.

(7) Transportation Modeling (TRM)

This refers to the entire process of mathematically modeling transportation systems and traffic flows, beginning with model development and continuing through the problems of interfacing with environmental impact assessment models such as those for air quality impacts.

Concerns in the Systems sessions involved disparities between standard transportation model outputs and the input needs of air quality models, ways to interface the two sets of models, and output accuracy and precision. In the Project sessions, problems were identified involving the ability of traffic models to supply certain output parameters necessary to operate air quality models, calibration and validity of predictions and failure to consider alternative energy futures in making forecasts.

Identified research needs, discussed in detail in Part III, centered on interfaces between air quality and energy models and the relationship of efficiency and accuracy to input needs and computation time.

(8) Study Planning and Analysis (SPA)

This pertains to the activities involved in the design of an air quality/transportation study, analysis of data and forecasts, and assessment of impacts.

Problem statements concerned guidelines for "worst case" analysis, level of effort, differences between analyses for situations with and without the possibility of pollutant buildup, and analysis of regional impacts on photochemical oxidants. Research needs related to the entire oxidant problem, especially interregional considerations, methods for analyzing CO background data, statistical determination of worst-case conditions, "best" use of ambient air quality data, and adequacy of typical analyses.

(9) Aerometric Monitoring (AMM)

This includes field monitoring of ambient air quality and meteorological parameters to permit assessment of regional and local pollution conditions and to permit validation and calibration of pollution-transport models.

Problem statements concerned post-project monitoring, choice of sites and their appropriate number for location-specific monitoring, and the inadequacy of existing ambient air quality data sources for use in both microscale and mesoscale air quality modeling.

Needs statements called for improvement in accuracy of data, better monitoring strategies to develop more complete data, and methodology for post-construction aerometric monitoring to evaluate the accuracy of forecasts of impacts made before construction.

(10) Integrated and Comprehensive Analysis (ICA)

This involves the trade-offs among air quality, transportation, and socio-economic goals in the transportation decision making process.

The problems mentioned included analysis of the cost-effectiveness of air pollution control, social costs, impacts on energy usage, conflicts between local and regional air quality improvement strategies, conflicts between air quality and other goals, and trade-offs between air quality improvement and other environmental objectives.

In summary, the listing and ranking of the most urgent workshop-identified issues are:

(1) Air Quality Modeling (AQM)
(2) Integration and Coordination of Interacting Federal Programs (ICP)
(3) Mobile Emission Factors (MEF)
(4) Education of the Public (EOP)
(5) Interagency Cooperation (IAC)
(6) Transportation Control Assessment (TCA)
(7) Transportation Modeling (TRM)
(8) Study Planning and Analysis (SPA)
(9) Aerometric Monitoring (AMM)
(10) Integrated and Comprehensive Analysis (ICA)

This list of issues establishes the scope and nature of specific research recommendations described in the next Part.

PART III: RESEARCH RECOMMENDATIONS

Contents

PART III: RESEARCH RECOMMENDATIONS

Introduction

In the course of the workshop sessions, an attempt was made to direct the attention of participants to the formulation of specific statements of needs for research and development work addressing the problems identified. This Part of the report presents a number of research recommendations designed to be responsive to these needs in an organized fashion. Thus, for each program recommendation, the discussion includes: (1) a statement of the technical nature of the problem; (2) a set of specific, achievable objectives for research contributing to the solution of the problem; and (3) a specification, stated as precisely as is feasible, of the desired "product" of the research/development effort.

Scope of Recommendations

In order to ensure that this discussion is sufficiently comprehensive, no attempt has been made to limit suggestions to research areas in which USDOT has current efforts underway, or over which it might feel it had administrative jurisdiction. This was done to ensure that USDOT management would retain the option of initiating involvement in new areas, or undertaking joint research and development efforts with other agencies. Further, no attempt was made to limit research needs statements to purely technical areas; some of the most important problems perceived by the user agencies attending the workshops were of a policy or other non-technological nature. Therefore the inclusion of research needs in policy and other nontechnical areas is essential to providing USDOT management with a complete picture of the problems faced by the state and local agencies. Omission of the nontechnical elements would distort that picture.

No a priori limitation has been placed upon the scope and magnitude of the research and development program to be considered. Rather, it is presumed that USDOT is aware of the substantial gaps which exist in transportation/air quality methodology, and is willing to consider the full range of

effort needed to fill those gaps, either unilaterally or in cooperation with other agencies.

Universality of Concern

The one unifying factor in the research needs presented is their universality of concern. These recommendations principally emphasize those topics felt to be of genuinely nationwide importance. At times, such a determination of scope is difficult to make but for the present purpose, recourse has been made to several sources of opinion. Of course, the results of the workshops described in this report were paramount among these sources. Additionally, results of other conferences, opinions expressed in other scientific forums such as the Transportation Research Board, priorities expressed by reviewers of the National Cooperative Highway Research Program (NCHRP) research proposals, writings in the transportation/air quality literature, and individual communications with known experts in the field have all been factored into the discussions below.

Research Recommendations Context

Before describing the research needs, it is important to understand the context into which the results must fit if meaningful solutions are sought. The following points are important.

- Many of the problems expressed at the workshops resulted from frustrations generated by intra-agency and inter-agency conflicts and uncertainties. Research solutions should not exacerbate these frustrations.
- In many cases, a problem solution involves acceptance of the results by other agencies. If those agencies are involved in the formulation of the proposal and jointly sponsor and conduct the research, implementation will follow more easily.
- The people expressing the problems are involved in day-to-day work and need common sense, pragmatic, simple and immediately implementable solutions to their problems.

- Solutions to many of the policy problems can be found if a solid and satisfactory technical base can be developed.
- Many of the input data necessary for a problem solution are deficient in accuracy and quantity. Therefore, complex and expensive methods for utilizing these data are not warranted.
- Much of the work necessary to develop problem solutions has already been done. In these cases, it remains primarily to mount an adequate development effort to ferret out, screen, and synthesize this information into forms suitable for general use.
- Applied research must result in discrete products which are implementable. Recommendations for further research, while sometimes necessary, do not constitute such usable products.
- The nature of research products should be heavily influenced by the resources and capabilities of potential users. Most state and local agencies lack the equipment and personnel to carry out very sophisticated analyses.

The research program suggested on the following pages recognizes these points. In connection with each problem area identified above, specific research objectives and specific research products are recommended. Also recommended are research steering and review committees to assist USDOT in ensuring the pertinence and usability of the work to be undertaken.

Program and Task Research

The recommendations are divided into two parts:

(1) Program-related Research, which has applicability to the three workshop-related categories; and

(2) Task-related Research, which has its principle applicability to only one of these categories.

The format and list of research recommendations in this part of the report are illustrated in the contents page to Part III.

Table I below shows how the Program and Task Research recommendations discussed in this Part relate to the priority issues identified in Part II. Reading across any line of the Table gives a complete view of the research program proposed in connection with that issue.

TABLE I

RELATIONSHIP BETWEEN RESEARCH RECOMMENDATIONS AND TRANSPORTATION-AIR QUALITY ISSUES

ISSUES	RESEARCH RECOMMENDATIONS														
	1. Program		2. Systems						3. Project					4. Policy		
	a	b	a	b	c	d	e	f	a	b	c	d	e	a	b	c
(1) Air Quality Modeling	×		×	×					×							
(2) Integ./Coord. of Federal Programs		×													×	
(3) Mobile Emission Factors													×			
(4) Education of Public						×										×
(5) Interagency Cooperation										×						
(6) Transportation Control Assessment						×		×								
(7) Transportation Modeling								×								
(8) Study Planning and Analysis											×					
(9) Aerometric Monitoring												×				
(10) Integrated and Comprehensive Analysis														×		

1. SYSTEMS ANALYSIS, PROJECT ANALYSIS, AND POLICY ALTERNATIVES: PROGRAM RELATED RESEARCH RECOMMENDATIONS

These recommendations pertain only to the two highest ranked issues, Air Quality Modeling and Coordination of Related Federal Programs. In each case, they treat topics which cut across the System/Project/Policy categorization used to classify the remainder of the recommendations. Work in these areas is a necessary prerequisite to meaningful progress in further, more specific research discussed under the latter categories.

Recommendation 1.a: General Air Quality Modeling

Statement of the Problem

To date, R & D efforts in the development of models for the dispersion of air pollutants have taken place on a haphazard basis, with little or no effective coordination or evaluation. Models have been developed in relative isolation, more often than not in response to specific problems, and with features and limitations responsive to the needs and resources (or lack thereof) of the developers. In some cases, a single basic mathematical formulation has been the subject of several independent model-building efforts, resulting in models which may manipulate the same input data through the same basic calculations via different computational procedures and thus arrive at different results, simply due to individual quirks in the models. Conversely, there are some models which are mathematically quite unique, and which hold considerable promise, but which have never been adequately evaluated due to funding or data constraints upon their developers. Some simply have been published only in very obscure quarters, or published incompletely (if at all).

One particular problem, requiring extensive evaluation, is the question of accuracy and reliability of the existing models. Currently there is great pressure to initiate use of very complex and expensive numerical-integration or "conservation of mass" models for use in cases of complex topography, especially in urban areas. Yet, little is known about their mathematical nature. Depending on their formulation and programming, they may tend to

suppress, propagate, or even magnify errors in their inputs. This can lead to situations wherein an agency multiplies its costs severalfold by adopting such a sophisticated model, and finds no real gain in accuracy over suitable and less expensive empirical calibration of an existing simpler model.

It would be useful to have developed as one element of an overall evaluation procedure, a standard battery of tests to evaluate the response of a model to known inaccuracies in specially-prepared test data.

As described below, a USDOT research effort could make two key contributions: first, to compile in systematic fashion all the available mathematical models applicable to dispersion of pollutants from transportation sources, and to devise and apply a standardized evaluation procedure to these models, and publish the results as a guide to potential users.

Objectives

- Compile systematically all published models for transportation/air quality analysis, with emphasis on those very commonly in use or seen to hold great promise of usability.
- Devise a standard procedure for evaluating the utility of the models, considering such factors as the following:
  - Type (Gaussian, numerical, etc.);
  - Scope of applicability (areawide transportation system, project analysis, at-grade, elevated, tunnels, etc.);
  - Inherent assumptions and their potential impact upon accuracy;
  - Limitations in usage due to assumptions or other factors;
  - Input data requirements;
  - EDP requirements (core size, program availability, etc.);
  - Computational efficiency (cost of typical analysis);
  - Sensitivity to errors in input data;
  - History of validation attempts (if any);
  - History of calibration attempts (if any); and
  - Accuracy and Precision.
- Subject the compiled models to the evaluation procedure, and compile results.

Steering and Review Committee

This should be a group composed of acknowledged experts in this field from Federal (USDOT and USEPA), state (transportation and air quality) and local (MPO and APCD) agencies. The Federal members should be official representatives of their agencies' modeling and research branches and should have the authority to commit their agencies to accepting a particular model as suitable for specified uses. State and local members should be from "user" agencies and should be qualified to advise as to the "implementability" of given models in terms of such factors as input data availability, resources required for use, etc.

Product

The end product should be a report or series of reports, periodically updated, presenting the results of the model evaluations in a format which can be used for selection of a model for a specified purpose. Especially useful would be a matrix-type tabular summary of factors such as those mentioned above which would enable at-a-glance comparisons and straightforward choices based upon a given user's priorities and constraints among those factors.

Elsewhere in the report can be provided basic information on strengths and shortcomings of each model, uses and applications to which it is particularly suited or unsuited, and guidelines for its use. Also useful would be detailed information on its cost-to-use measured by the magnitude and difficulty of acquisition of inputs, manpower and computer time requirements, etc. In combination with the results of the study of accuracy already discussed, it should be possible to develop some rough index of cost effectiveness and marginal effectiveness (increase in quality of results per additional expenditure of resources) between the various models.

Recommendation 1.b: Identification and Coordination of Issues

Statement of the Problem

There exist a number of technical issues, for which guidance must come from Federal agencies, which have not been adequately addressed. These include

such items as:

- Guidelines for transportation/air quality plan "consistency" assessments required under FHPM 7-7-9;*
- Policy on deliberate use of decisions regarding transportation supply to control land use for air quality purposes;
- Approaches to evaluation of transportation control strategies;
- Approaches to consideration of "growth inducement" for transportation project Environmental Impact Statements;
- Integration of air quality concerns with those of energy, water, transportation, and land use; and
- Information dissemination to "user" agencies.

In some of these areas, the requisite Federal guidance is lacking and is the subject of more detailed recommendations below. In many instances, however, Federal policy and guidelines do exist but are fragmented between two or more agencies with differing statutory responsibilities and views of priorities. Thus the guidance received from these agencies, most notably USDOT and USEPA, is sometimes seriously inconsistent leaving state and local agencies in a quandry as to their proper course of action in advancing transportation programs. In other cases, the policies and guidelines have not been well publicized outside the Federal government and at times not even outside the originating agency. Thus state and local program officials may flounder for lack of guidelines which are actually available if they only were aware of it.

There is, therefore, a need for a research project to compile what technical guidance is available on these and related issues. The compilation should highlight the similarities and the conflicts between different agencies' views of the same issues. One or more "issue papers" may be developed which, insofar as they documented consistency between agencies, could serve as substantive guidelines for state and local agencies in addressing the issues. To the extent that the "issue papers" reveal omissions, inconsistencies, or conflict between the Federally led agencies, they may serve as a catalyst

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*Development of Air Quality Guidelines. U.S.DOT FHWA FHPM 7-7-9, December, 1975.

for heightening awareness of such problems and motivating efforts as solution by negotiation.

Objective

Develop a series of joint USDOT-USEPA "issue papers" setting forth the agencies' existing policies with respect to the above technical issues and related topics which may prove relevant. These should be organized in such a manner as to compile separately those technical questions on which the agencies are in agreement (to serve as "user" agency guidelines) and disagreement (for future use as a stimulant to negotiation).

A natural follow-on activity would be a series of independent technical investigations of the "issues" on which the agencies are in substantial disagreement to determine the technical bases for possible compromise agreement.

Steering and Review Committee

For each issue, a panel should be formed composed of appropriately expert members of Federal, state and local agencies. Representatives of the Federal agencies should be empowered to affirm that the opinions they express are the official positions of their agencies.

Product

USDOT and USEPA should issue a series of joint guidelines documents, approved by the heads of both agencies, setting forth the joint policy of the agencies on these issues, to the extent that agreement exists. Conformance to these guidelines would then be binding upon organizational subunits of those agencies as well as upon state and local agencies.

Note that it is not the purpose of this recommendation to propose development of new guidelines, policy and technical information. To the extent that such material is felt to be needed, it is covered in the specific recommendations below. Rather, this proposal centers on the compilation of existing material, and its circulation to all interested and affected parties in a usable format.

2. *SYSTEMS ANALYSIS TASK-RELATED RESEARCH RECOMMENDATIONS*

The following recommendations arise from issues principally discussed in the systems analysis group sessions of the workshops. It should be noted, however, that some of these issues arose in, or bear strong relationships to other issues arising in, the Project and/or Policy sessions. In such cases, the issues have been treated under the heading of the session to which they seem principally pertinent.

Recommendation 2.a: Improvement of System Air Quality Models

Statement of the Problem

The workshop discussions revealed considerable sentiment among participants that existing methodologies for system air quality analysis are inadequate. Long-felt reservations regarding the scientific validity of many of the standard analysis techniques has grown into open skepticism of the significance of the results produced by these techniques. A vocal minority feel that inadequacies are so great as to reduce them from genuine planning tools to relatively meaningless administrative requirements.

Most transportation agencies follow a common technique in preparing the systems analyses required by FHPM 7-7-9. This involves the use of specified traffic flow parameters and USEPA emission factors in a system emissions model, such as FHWA's SAPOLLUT (Special Area Analysis Pollution Model), to calculate the total emissions expected from the vehicular fleet using the urban area's transportation network, under various future-development scenarios.

These emissions calculations are related to the National Ambient Air Quality Standards in various ways. Most commonly, use is made of a simple proportional or "rollback" technique which essentially scales measurements of current pollutant levels up or down proportionally to emissions forecasts. A more sophisticated approach involves the use of area-wide pollutant dispersion models, such as the Stanford Research Institute's APRAC-2 (model developed by SRI under the auspices of the Air Pollution Research and Advisory Committee - APRAC - and the USEPA).

Criticisms involve both the emissions and dispersion phases of these analyses. Emission factors currently proposed by EPA in their publication AP-42 Supplement 8* are felt to be unrepresentative of freeway driving cycles, leading to gross overpredictions of future pollution in areas where a large proportion of the VMT is on freeway-type facilities. (This is more fully discussed in the separate recommendation on improved Mobile Emission Factors, Recommendation 3.e.) Dispersion models, on the other hand, are felt to be either too crude or so oversophisticated that propagation of the errors in their many input parameters may lead to serious error.

Existing dispersion models do not treat several important types of problems, including especially evolution of photochemical pollutants and interregional transport of pollutants. This is now of nationwide concern due to the increased emphasis placed by USEPA upon adequate consideration of photochemical oxidants in air quality planning and State Implementation Plans. Lack of an adequate photochemical model places transportation planners in an impossible position in attempting to make the proposed project demonstration, as required by Federal law, in conformance with those Implementation Plans.

Objective

Based on the outcome of the general survey of air quality models proposed in Recommendation 1.a, select, modify, and/or develop a photochemical air quality model or models suitable for use in the analysis of the effect of transportation system changes on regional air quality and interregional pollutant transport. Ideally such a model should also be usable for the analysis of nonreactive pollutants (i.e., the latter should be a simplified limiting case of the more general photochemical model).

Steering and Review Committee

This would be the same panel proposed for the generic research on models proposed under Recommendation 1.a.

*Compilation of Air Pollutant Emissions Factors; AP 42; April, 1973. Revisions to Automotive Emission Factors, to be published.

Product

The desired product is one or more suitable regional models for reactive (photochemical) pollutants in a ready-to-use format. This should include computer programs prepared in common computer languages, prepared card decks or other needed software, users' manuals, etc.

Construction of the models should be in completely modular form so that data modules (e.g., chemical reaction rates) can be easily changed as new experimental data becomes available. The model should be computationally efficient and its complexity and accuracy should be commensurate with the usual quality of the input data it requires.

The product should include provision for an ongoing periodic update service, maintenance of the program on a computer, and access to it from FHWA Division offices as a service to state and local agencies without the necessary resources for implementation independently.

The product should also include instructions for the application of the model(s) to regional analyses according to specified guidelines. These should be developed, agreed to, and officially promulgated jointly by FHWA and USEPA.

Recommendation 2.b: Calibration and Validation of Models

Statement of the Problem

This problem is equally applicable with respect to Systems and Project work; for convenience it will be fully discussed here.

In general, most pollutant dispersion models - both for systems and projects - have not received adequate validation. (This refers to verification of their ability to mathematically reproduce measured existing conditions, and is to some extent an indication of the degree of trust which can be placed in them for forecasting purposes.) Generally, this has been due to the great cost of obtaining the necessary ambient air quality and meteorological data, and the extensive electronic data processing resources required to perform the validation in a reasonable amount of time.

Calibration of models is also a topic which has received little attention. (This refers to the development of empirical factors to permit the use of a model in attacking problems whose conditions are significantly different from those for which the model was designed, e.g., calibrating a model for at-grade highway sections to make it usable for analysis of elevated sections.) Again, the data and computational resources required have been a major stumbling block. Further, it must be candidly recognized that the reworking and improvement of others' work is not the type of research project likely to attract the spontaneous interest of the academic researchers responsible for most model development to date.

There is thus a definite need for a major research effort to improve, calibrate and validate models now in existence. This may be done by the program outlined below.

Objectives

- Study the most promising existing system and project air quality models (identified by research under I.a above) to determine the data base needed for adequate validation and calibration.
- Assemble existing data and develop new data to fill the gaps, producing a "national" data base for validation.
- Validate and test for sensitivity to input errors the system models developed under 2.a above and project models developed under 3.a below using the above data base.
- Develop requirements and criteria for accuracy of input data for given levels of assurance of accuracy of resultant forecasts.
- Develop calibration factors for application of appropriate models to area-specific and project-specific conditions.

Steering and Review Committee

Same as in I.a above.

Products

- A report detailing the contents of the data base and describing how to gain access to it.
- A report (or series of reports) giving specific results on accuracy and sensitivity of the models tested for validation.
- A report outlining the application of calibration factors developed for area- or location-specific problems.

Recommendation 2.c: Improve "Consistency Assessment" Process

Statement of the Problem

The Federal-Aid Highway Act (Section 109j) requires an annual determination of "consistency" between the transportation system plan for an urban area and the State (air quality) Implementation Plan for the area. In the workshops, considerable concern was expressed over whether this requirement was being adequately met.

Many participants felt that very serious administrative and technical problems exist in the current process for making consistency determinations. The fundamental guideline tool available to state and local agencies is the FHWA USEPA "green book,"* issued over two years ago. Much of the content of the "green book" is becoming outdated and, in any event, experience has shown that some of its guidelines are too broad and vague to provide effective guidance. FHWA recently attempted to interpret and better define some of those interpretations, and in some cases the disagreements are quite serious.

A thorough updating is needed centering on a substantial detailing of the guidelines and, most importantly, development of specific criteria for evaluating consistency. Lack of such "official" criteria has led to contradictions not only between FHWA and USEPA, but at times even between USEPA Regional Offices. Negotiation of these disagreements and issuance of a joint USDOT-USEPA green book revision is a critical need.

Additionally, it should be recognized that at least in part this problem is traceable to the manner in which system air quality analysis is treated in

*Guidelines for Analysis of Consistency between Transportation and Air Quality Plans and Programs. Prepared jointly by the FHWA and USEPA; April, 1975.

the governing Federal regulation, FHPM 7-7-9. Therein system air analysis is treated as a purely procedural matter, in satisfaction of the applicable requirement of the Federal-Aid Highway Act of 1970. The regulation goes insufficiently beyond the Act in proposing a reasonable definition of consistency, or in setting criteria for consistency assessment. This leaves these matters open to possibly hostile definitions and interpretations by USEPA and the many other agencies which take part in the process. Therefore, a high priority must be placed upon reevaluation of FHPM 7-7-9 to correct these deficiencies. Concurrently, other regulations governing transportation planning could usefully be reviewed to determine how they could be modified to strengthen the role of air analysis as a decision making factor in the overall planning process. Maximization of air quality and other environmental benefits should be placed on a comparable footing with other criteria used for transportation program decision making. This may alleviate the hostility received from personnel of some environmental agencies who appear to feel that prior policy decisions on transportation development are so "locked in" that all current transportation planning is merely post-facto justification of decisions already made.

Objectives

- Revise FHPM 7-7-9 to provide an appropriate definition of "consistency" determination (formally agreed to and co-promulgated by EPA).
- Revise the FHWA-USEPA "green book", in cooperation with EPA, negotiating existing conflicts in interpretation and better detailing the assessment criteria therein.
- Develop joint USDOT-USEPA guidelines for the uniform application of these criteria by their respective Regional Offices (to be binding upon the latter).
- Develop suggestions for alternatives to the existing mechanism for decertification of the planning process as an incentive for coordinating transportation and air quality planning.

Steering and Review Committee

The same panel proposed under Recommendation I.a.

Products

- A suitably revised "green book" guidelines document.
- Application guidelines jointly issued by USDOT and USEPA.
- A report on alternatives to decertification.

Recommendation 2.d: Public Information/Education

Statement of the Problem

Environmental protection experts are of the firm opinion that over a period of time it will be necessary for gradual but significant changes to take place in land use and related transportation system development for a variety of reasons - environmental, energy related, and social. This general philosophical position is widely shared among transportation planners, albeit with some significant disagreements over the nature and magnitude of such changes. At this time, however, it is obvious that with the exception of a vocal but small minority of environmental advocates, the general public does not share a belief in the inevitability of such societal changes; nor, indeed, does the public even display full recognition of the magnitude and import of today's environmental problems. Thus, when environmental and transportation agencies attempt to advocate and institute programs in step with these perceived needs, they meet with apathy or open hostility.

It is therefore evident that there is justification for an intensified public relations effort to increase public awareness of these problems and of the need for significant changes. In the past, the USEPA has spearheaded such efforts. It may be assumed that the new Department of Energy (USDOE) has initiated, or will shortly be initiating, similar efforts. It still remains for those agencies and the USDOT to reach a consensus on the currently-disputed nature and magnitude of those changes, and then to participate with all its resources in the necessary multilateral public education effort.

It is understandable that the Department may be reluctant to undertake public information efforts in this area until its own policy regarding the future evolution of transportation, and long-range strategies for public investment in the various modes, are more fully developed. Some pertinent research is already underway. Hopefully it will not be long before USDOT's position on these matters is well-developed enough to justify intensifying its current efforts at public education. In the interim, it is valuable to continue such special-purpose efforts as the current carpooling promotion campaign; however, in the long run a more comprehensive and better-funded effort, well integrated with parallel efforts by USEPA and the USDOE will be needed.

Objectives

- Assemble or develop a public education package for use by state agencies with emphasis on air quality and health, and the necessary related changes in life style in general and transportation in particular to promote better air quality.
- Develop an air pollution index package for use by news media in connection with weather forecasts, etc. to heighten public awareness of air pollution.

Steering and Review Committee

Air quality, public health, and public relations experts drawn from USEPA, USDOE, USDOT, and state and local air quality and transportation agencies.

Products

- Ready-to-use package(s) of multimedia educational materials which can be assembled into a variety of public information programs of varying sophistication of content, suitable for use in connection with groups of different ages, levels of education, etc. This should be accompanied by a "user's manual" report which outlines various applications of the package(s) and suggests implementation strategies.
- A package which presents a suitable index of pollution in a simple, media-ready format. This could be furnished as a continuing information service

to newspapers, radio and television stations and any others making regular use and public dissemination of weather information and forecasts.

Recommendation 2.e: Evaluation of Transportation Control Strategies

Statement of the Problem

Federal law requires the preparation of State Implementation Plans (SIP) for the control and reduction of air pollution in heavily-polluted areas. In many cases these SIPs must necessarily contain a Transportation Control Plan or TCP. Considerable frustration is felt by transportation planners in trying to deal with the problems of implementing SIPs and TCPs to which they had no significant input. Most SIPs and TCPs extant were unilaterally imposed by USEPA with little local input. A few were actually developed and submitted for EPA approval by the states themselves, but even these were generally prepared by environmental protection agencies with little or no significant opportunity for input by transportation agencies. This is reflected in the nature of many of these plans. Heavy emphasis is placed upon strategies such as massive capital investment in mass transit, whose benefits are uncertain but whose nature is compatible with the philosophy of the SIP drafters, while equally important measures such as traffic flow improvements were sometimes given short shrift in the original development of SIPs and TCPs simply because the lead agency (normally an environmental protection agency) lacked the necessary in-house expertise and did not vigorously seek outside assistance (or, due to philosophical differences and frictions, did not want such assistance).

To date, little has been done to evaluate on a systematic basis the cost-effectiveness of proposed transportation control measures. The most glaring example is in the area of advocacy of transit improvement. Huge capital investments and operating subsidies are proposed to lure travelers out of the automobile, but no real analysis is done to determine the cost-effectiveness compared to alternative investments of the same resources. (For example, would it be more cost effective in terms of pollutant emission reductions for a given level of funding, to invest the same amount in subsidization of

"hardware" pollution control measures such as inspecting and maintaining automotive pollution control devices, or subsidizing installation of such devices on older vehicles?) As another example of much broader societal costs which go unestimated, it is proposed in some urban areas to abandon construction of all radial freeways as a matter of principle, without study of the "price" of such program changes in terms of future casualties to persons and property due to continuation of existing congested traffic on substandard surface arterials. (It would not be surprising to find that such accident costs could be documented with far more scientific validity than existing estimates of public health disbenefits of air pollution at threshold levels.)

As mentioned above, most of the lead agencies responsible for the original round of SIP/TCP development lacked the necessary expertise to consider and evaluate sophisticated transportation system changes. Therefore, SIPs now generally concentrate on strategies which reduce gross vehicle miles travelled, and make oversimplified assumptions about average vehicle speeds. This sometimes leads to "official" estimates of urban area emission rates and patterns whose validity is seriously doubted by transportation planners. In numerous cases it leads to the conclusion that a drastic reduction in vehicular travel is needed to achieve the air quality standards. The strategies necessary to reduce VMT by the necessary amounts immediately face strong public opposition on grounds of negative economic impact and unacceptable interference with mobility. This negative public reaction damages the image and credibility of the entire pollution-control effort, which is to the benefit of no one.

Two areas of "hard" engineering/scientific research immediately suggest themselves from the above considerations. First, it is clearly necessary to perform research in the form of parametric studies which will provide as an output a summary of at least the more obviously quantifiable societal costs and benefits of the commonly advocated and used transportation control strategies. Of particular concern would be the development of some systematic basis for ranking such strategies in terms of their cost effectiveness in reducing pollution levels. Such results would be an extraordinarily valuable input to the new round of SIP updates mandated by the most recent amendments to the Clean Air Act.

Second, an effort needs to be made to develop, quantify, and compile, ready for use, a new bettery of strategies to supplement the existing "hardware" and "travel reduction" measures. In some cases it may be possible to reduce dependence on such measures by the interactive use of pollutant emissions models and traffic flow and queueing models to evaluate the air quality impact of strategies which do not necessarily reduce VMT, but do reduce emissions through improvements in average vehicular speeds and reduction of time spent idling in queues. Under typical congested urban traffic conditions, in which speeds are very low, the emission reduction associated with such speed improvement may far exceed that from any reasonably proposable VMT reduction. This is due to the fact that the variation with speed of carbon monoxide and hydrocarbon emissions is a highly nonlinear inverse function, so that at low speeds, even a small increase may cause substantial emission reduction.

This approach has always been available to air quality planners; it has heretofore largely been unused due to the SIP lead agencies' lack of expertise in traffic analysis necessary to evaluate the benefits and quantify them sufficiently to justify taking "credit" in an SIP. There is therefore in this an opportunity for USDOT to make a substantial contribution to, and improvement in, the SIP process by undertaking comprehensive research to develop and quantify the benefits of a new range of transportation system management type strategies and making the results available in a standardized, ready to use applications package. It should be noted that such traffic flow improvement measures as "block" synchronization of traffic signals, provision of left turn lanes, adoption of right-turn-on-red regulations, minor widening of travel lanes, control of on-street parking, etc. are already being undertaken in many of the same urban areas now subject to unpopular VMT-control type SIPs. Though these improvements were initiated in the normal course of traffic engineering, they nonetheless may have worthwhile air quality benefits which should be "credited" in air quality planning, leading hopefully to reduced dependence on less acceptable measures.

Objectives

- Carry out a comprehensive study of transportation control strategies already in common use or commonly proposed around the country. Analyze

existing methodologies for quantifying their air quality benefits and compare to actual results where possible. Develop new quantification methodologies for existing strategies where necessary.

- Develop new strategies which integrate existing or easily developed traffic, queueing, and emissions models to permit quantification of transportation system management (TSM) actions undertaken in the normal course of traffic engineering.
- Develop and apply a procedure for evaluating the most important societal benefits and disbenefits (other than air impacts) of these strategies, i.e., such parameters as energy consumption implications, safety implications, etc.
- Develop and apply a procedure for estimating the cost-effectiveness of all the strategies considered (old and new) in terms of emission reduction likely per unit investment.
- Compile the results of these investigations in one or more "planning manual" type reports which report on the characteristics, nature, benefits and disbenefits, and cost-effectiveness of the strategies considered. This should be directly usable by air quality planning personnel.

Steering and Review Committee

The same as proposed under Recommendation I.a above.

Product

A report or series of reports detailing the applicability, benefits and disbenefits, and cost-effectiveness of all the strategies, both traditional and newly-developed.

The report should present methodologies for calculating, for planning purposes, the benefits and effectiveness attributable to each strategy. These should be presented in a format suitable for application by personnel with technical training but no particular traffic-analysis expertise, preferably in monographs and graphical solutions for simple techniques, and canned computer programs for more complex ones.

All results, recommendations, and methodologies appearing in the final report(s) should be certified as acceptable for planning purposes by both USDOT and USEPA before official issuance of the report.

Recommendation 2.f: Improvements in Necessary Transportation Modeling, Methodology and Coordination with Air Quality Modeling

Statement of the Problem

Air quality models (both for emissions and dispersion) now tend to be developed relatively independently of traffic and transportation models. Normally, the developers of air quality models are experts in fluid mechanics and related fields, while traffic analysts are most commonly drawn from engineers with civil engineering type backgrounds. As a result, each is unfamiliar with the capabilities and requirements of the other's work.

As a result, the air quality model when made available to the "user" very often requires input factors which are not readily available from any standard transportation planning/traffic analysis system. The most evident current examples are found in emissions models where even the obsolescent AP-42 Supplement 5* methodology requires inputs such as vehicle classification by nonstandard categories, percentages of hot and cold running engines, etc., which are not available from standard traffic forecasting tools. Indeed, even basic traffic-volume inputs may give trouble, since the air quality model will require (for microscale analysis) peak-hour volumes, while the traffic model supplies Annual Average Daily Traffic (AADT). The air quality model may require many intermediate-year projections while the traffic model provides only the 20-year horizon forecast and provision of intermediate data may be very expensive to supply, etc. In the past, this lack of coordination has led to the development of models for air quality, now widely in use, which are substantially oversophisticated in that they require input data which cannot be supplied to any reasonable degree of precision. Piling this inherent error upon the many mathematical approximations necessary to develop the air quality model itself, leads to the classic accusation that the air quality analyst is attempting to "measure jelly with calipers," with results which may be totally untrustworthy as a basis for decision making.

* Revised Automotive Emission Factors, December, 1975.

It was generally agreed that the solution to this problem must be a synergistic one, that is, a systematic study of the requirements and capabilities of both traffic and air models must be made resulting in the setting of specifications for revision of current models and/or development of future models which will be compatible with each other and which will produce results in which the "guesstimation" of inputs will have been minimized.

Objectives

- Survey those air quality models selected under the general air quality research (Recommendation I.a) as being particularly useful to determine their detailed requirements for inputs from traffic and transportation models. (Include both emissions and dispersion models.)
- Review the traffic/transportation forecasting models most commonly in use at the present time and analyze their capability to provide the necessary inputs to air quality models.
- To the extent possible, provide recommendations as to how any inadequacies identified in the traffic models may be remedied by their straightforward modification. Provide detailed technical recommendations and estimates of both developmental and operational costs.
- Where identified inadequacies cannot be remedied by straightforward modification of existing traffic models, recommend either (1) development of new traffic models, or (2) limitations in the data demands by appropriate theoretical limitations placed upon development of new air quality models. These recommendations should be developed on a basis of cost-effectiveness.
- Develop technical specifications for better interfacing between the most popular air quality and traffic models so that a minimum of manual calculation or adjustment is necessary to input traffic data into the air quality models. (These specifications should also apply to the development of future traffic and air models.)

Steering and Review Committee

Experts in traffic and air quality modeling drawn from Federal (DOT and EPA), state, and local agencies.

Products

- A report summarizing the important technical aspects of available transportation and their adequacies/inadequacies as sources of traffic input for standard air quality models. This should include a section dealing with recommendations regarding any serious inadequacies identified.
- Any necessary manual(s), computer card deck(s), or other software necessary for the modification and use of the selected transportation/traffic model(s) in conjunction with selected air quality models. This is to include the necessary software for directly interfacing the two so as to minimize manpower requirements in obtaining air quality results.

3. *PROJECT ANALYSIS TASK-RELATED RESEARCH RECOMMENDATIONS*

The recommendations below were developed from the discussions which took place in the Project Analysis sessions of the workshops. It should be noted that to save space, the discussion of model calibration and validation, which was begun under 2. Systems Analysis Research (Recommendation 2.b above), will not be repeated here. However, the discussion and recommendations are as applicable to Project work as to Systems Analysis and should be considered integral to this section as well as to the Systems section.

Recommendation 3.a: Improve Microscale Pollutant Dispersion Models

Statement of the Problem

Most workshop participants in the Project Analysis sessions were in agreement that existing mathematical tools for predicting the microscale effects of dispersion of pollutants in the vicinity of specific project locations are seriously inadequate.

There are a variety of reasons for this feeling. Some models, notably those of the "Gaussian" diffusion type, contain assumptions which cause them to grossly overpredict or underpredict concentrations under certain atmospheric conditions. In some cases, this can lead to false forecasts of violations of the National Ambient Air Quality standards and to consequent difficulties in gaining approval for project Environmental Impact Statements. Other models, such as the numerical-integration of "conservation of mass" type, require such extensive air quality measurements for calibration that they are unreasonably expensive, time consuming, or difficult to use.

In addition to these inherent mathematical limitations, there also arises the question of applicability. Virtually all models in general use at the present do not adequately treat situations of very uneven topography, most importantly the urban "street canyon" effect. Even for the topographies for which current models were designed, little or no scientifically valid effort to calibrate or validate them was done before placing the models in general use.

It would be most useful, therefore, to follow-on the general air quality research mentioned under Recommendation 1.a above by a two-pronged research effort to first carry out any straightforward modifications of existing models which hold promise of increasing their utility and/or accuracy in a cost-effective manner, and second develop any new microscale model which the general research identifies as a necesary tool. Calibration and validation of these new tools should be carried out in a manner analogous to the recommendations already made under 2.b above.

Finally, it would be highly useful to perform studies which would analyze some typical major projects to determine whether the overall procedures used to estimate their air quality impacts were conservative, accurate, or optimistic compared to actual before/after measurements of air quality. Comparisons could be made between original AQ estimates done for the project EISs, new estimates done using the latest emissions and dispersion prediction methodology, and actual measurements. The results could lead to valuable insight as to whether the newer methodologies, with their much greater complexity and taking into account many more factors, produce results which in the final analysis are any more accurate than models in use years ago.

Objectives

- Referring to results of the general air quality research recommendation (1.a above), proceed to develop modifications of existing air quality models which appear to be cost-effective in providing more accurate and/or less expensive results.
- Also, proceed to develop any new models identified by the general research as especially desirable to close gaps in existing available methodologies. Validate/calibrate these models in a manner analogous to the recommendations of 2.b above.

- Select a limited number of major highway, airport, etc. projects for which thorough air quality studies were performed during project development (or which can be performed retroactively from available data) and perform new state-of-the-art predictive analyses and post-completion ambient measurements. Compare old and new forecasts to post-measurements and draw conclusions as to the reliability of the original air quality analyses and the marginal effectiveness (marginal improvement in accuracy) afforded by the newer forecast methodology.

Steering and Review Committee

The same group identified under Recommendation I.a.

Products

- One or more improved and/or new air quality model(s) or system of model(s) in ready to use form, with all necessary manuals, card decks, and other software. The model(s) should be validated and calibrated sufficiently to be capable of application to site-specific topographic, meteorological, geometric, and emissions conditions. Empirical factors such as dispersion coefficients should be state-of-the-art. All automobile-related pollutants, including particulates, should be treated insofar as the state-of-the-art permits. Model construction should be modular so that changes are easily made. Model(s) should be computationally efficient and complexity and accuracy should be only sufficient to be commensurate with likely quality of inputs (i.e., model should not be oversophisticated to no purpose).
- Provide an ongoing program for updating, and maintain the program on a computer with access from USDOT field Offices as a service to user agencies with insufficient resources for direct use.
- Provide a manual of instructions for application of the model(s) to typical project analysis situations (as distinct from the computer program users' manual, which deals principally with the running of the program, rather than its applications).
- Select a limited number of completed transportation projects and carry out new, state-of-the-art "forecasts of the present." Compare to

original air quality estimates made for the projects and to before/after air quality measurements and comment upon the adequacy of the original forecasting methodologies and the marginal benefits of using newer predictive techniques.

Recommendation 3.b: Improve Information Dissemination through Interagency Cooperation/Coordination

Statement of the Problem

Most analysts agree that drastic improvements are needed in the procedures used by agencies of the Federal government in disseminating technical information on air quality analysis to the "user" agencies at the state and local levels.

There are three types of problems which are most complained about: Information may be disseminated in a technically inadequate form, not ready to use; information may not be made available in a timely manner; and information may be imposed upon user agencies and its immediate application mandated by one Federal agency without adequate coordination and agreement with the other Federal agencies impacted.

The first and second of these problems are well illustrated by the history of EPA's previous emissions-calculation methodology, the so-called AP-42 Supplement 5 procedure. This was made available through unofficial channels, in draft form, as early as April, 1975. However, "official" promulgation was long delayed and when it came was in the form of merely an updated reprint of the original research findings report, with little effort given to setting it up as a quickly and inexpensively usable tool. Despite the complexity of Supplement 5, especially in systems applications, no effort was made by EPA to furnish the necessary computer "package" of manuals and software. This resulted in the phase-in schedule being unduly prolonged, with "official" promulgation to user agencies not occurring until April 12, 1976, and a phase-in schedule from FHWA not being issued until December 8, 1976. Final implementation was not required until 120 days later, or almost two years

after the factors' initial publication was approved in draft form. By that time, of course, Supplement 5 was obsolete and was in the process of being replaced by the current Supplement 8, even though most agencies were still not geared up to use Supplement 5.

The new emission factors, Supplement 8, illustrate well the third type of problem. Since their issuance in draft early this year, EPA has pressed for their immediate adoption, in complete contradition to FHWA which has repeatedly requested a delay while their technical adequacy is examined. Details of the technical arguments need not concern us here (they are discussed under Recommendation 3.e: Mobile Emission Factors below); the present concern is that "user" agencies are caught in an impossible position between one agency insisting on the use of a methodology and another insisting on delay.

These problems are already a serious impediment to state and local agencies' ability to deal adequately with the rapid evolution of both the Federal requirements themselves and the methodologies developed to satisfy those requirements. Given the constant accelleration of both administrative demands and technological development to permit these problems to continue is to steadily diminish the states' and localities' potential for discharging their statutory and regulatory duties.

Objectives

It is recommended that USDOT take the lead in establishing an interagency information clearinghouse in cooperation with USEPA and any other relevant agencies. Specific tasks include the following.

- Develop guidelines for originators of technical information and new methodologies to ensure that they are documented and packaged in a manner most immediately usable, and at minimum cost, by client agencies. Such items as nomenclature, computer programming details, input-output formats, etc. should be standardized.
- Review and evaluate new methodological packages developed under other Recommendations and via other programs. Test their accuracy and precision

against standardized data and comment on their utility compared to models already in use, and on their particular strengths, weaknesses, suitabilities, and unsuitabilities.

- Set up and operate a new and direct distribution system for these information packages, by-passing the tedious Washington-to-Regional Office-to-Division Office-to-state-to-locality chain which now wastes so much time.
- Provide regular training opportunities, both centrally and on a "road show" basis, for users to become thoroughly familiar with operation and application of the disseminated methods. This should be set up on a formal repetitive schedule to allow for attrition of personnel in user agencies over a period of time. It should not be a loose, informal, one-shot type of effort.
- Provide an active feedback mechanism whereby responses from users of new methodologies may be used to influence the course of further research. This should be a serious, full-time responsibility of specifically assigned, full-time staff.

Steering and Review Committee

Appropriately qualified technical experts from DOT and EPA plus at least one or two representatives of "user" agencies well-qualified to comment on the usability of product packages.

Products

- Regularly disseminated packages of air quality technical information, accompanied by suitable commentary and applications information.
- Regular and periodically repeated training opportunities.
- A mechanism for response and commentary on new methodologies to be made by "user" agencies, and fed back to parties engaged in developing other new methods.

Recommendation 3.c: Improved Specifications for Study Planning and Analysis

Statement of the Problem

This recommendation is the project analysis analogue of 2.c (Improve "Consistency Assessment" Process).

At the present time, there exist no up-to-date guidelines regarding the necessary level of effort and extent of analysis for project related air quality analyses, including project air quality reports and air quality sections of project Environmental Impact Statements.

Several years ago, the USEPA published their document, "Guidelines for Review of Environmental Impact Statements: Volume I: Highway Projects", which set out some criteria in this area. However, continued use of this document for general guidance suffers from several problems. It is written in rather general terms with little specific technical guidance. It is obsolete - dating from before such contemporary issues as Indirect Source permits, nondegradation, etc. It is written from a reviewer's, not a writer's, point of view.

Beyond that document, however, guidance for study contents is almost totally lacking. FHWA's regulations are especially deficient in this regard. FHPM 7-7-9, which is the applicable regulation, is almost entirely administrative and procedural in content giving virtually no technical or editorial direction to the writer of such studies.

Guidance is needed in such diverse areas as: proper definition of what constitutes "worst-case" conditions; identification of the pollutants appropriate for consideration under various scenarios; reasonable limits to extrapolation of otherwise inadequate ambient data; identification of suitable and appropriate methodologies for analysis of various types of problems; definition of what constitutes satisfactory demonstration of "conformance" with air quality standards and with State Implementation Plans; and many other topics. To have such guidelines available in complete and frequently updated form, with prior agreement by both the lead agency (USDOT) and the review agency (USEPA), would do much to reduce the currently excessive delays and demands for endless revision connected with EIS air quality analysis.

Objective

Form an interagency taskforce with USEPA and review current requirements for content and substance of EIS air quality analyses. Update these requirements in the light of current knowledge and issue a new guidelines document which has official approval of both agencies and is binding upon Regional Offices and client agencies of both DOT and EPA.

Steering and Review Committee

Technical personnel drawn from USEPA, USDOT, and state and local agencies responsible for preparing EISs. In addition to air quality experts, the panel should include policy making personnel.

Product

An updated report presenting state-of-the-art Guidelines for Preparation of Air Quality Analyses for Environmental Impact Statements.

Recommendation 3.d: Improve Methods and Procedures for Aerometric Monitoring

Statement of the Problem

Ambient air quality data is required for several purposes in connection with project air quality studies. Its simplest use is in the determination of "background" or ambient levels of pollution, i.e., levels to be expected even in the absence of the proposed new transportation project. To these background levels the analyst then adds forecasts of concentrations due to the new project to facilitate the necessary determination as to whether the completion of the project and its subsequent use is likely to cause or exacerbate violations of the National Ambient Air Quality Standards.

More sophisticated uses of aerometric monitoring include the use of the data for validation and calibration of mathematical models for use in particular problems, as is discussed more fully under Recommendation 2.b above.

Acquisition of the necessary data for these purposes is a continuing problem to transportation agencies, especially those of the smaller, less-affluent

states and localities. Generally, these agencies find it financially impossible to adequately perform special monitoring studies specifically for transportation project planning. However, secondary sources of such data are also inadequate. Data from the EPA-supported Continuous Air Monitoring System (CAMS) program is generally of little use due to inappropriate location (for transportation planning purposes) of the fixed monitoring sites. Some states have tried reliance on consultants to perform such studies to avoid the administrative problems attendant upon setting up new programs through a slow-moving civil service system. However, costs of such studies are often prohibitive.

Several possibilities exist for relieving this burden, including development of models with minimum ambient data requirements, development of a "bare bones" mobile monitoring laboratory package, better coordination of CAMS data acquisition, and special arrangements for grants to states for equipment acquisition and operating costs. All these should be thoroughly explored, in full cooperation with USEPA.

Objectives

- In concert with the monitoring branch of EPA, review ambient air quality requirements of popular existing air quality models.
- Develop a "bare bones" (minimum expense) mobile laboratory package of monitoring equipment suitable for acquisition and use by states with limited financial resources. This may include encouraging and funding the development of very low cost monitoring instruments. Coordinate with EPA a program for furnishing states with financial assistance for acquisition and operation of these packages.
- Establish a central test facility, by suitably instrumenting available high-traffic-volume highway locations, where states may receive assistance in obtaining air quality data needed to calibrate pollution dispersion models for their own needs or to validate new models developed by agencies and their consultants.
- Develop a standard set of test data, most particularly of wind speed, direction, and sigma, at numerous locations in the near field of typical highway and airport cross sections. This should be made available to

researchers for the more rapid development and evaluation of new numerical models which require this data for their calibration.

In concert with the EPA operators of the CAMS program, review CAMS monitor siting and make recommendations as to the extent to which new locations, or planned relocation of existing sites, may be integrated with short and long term needs for data for transportation system and project planning.

Steering and Review Committee

Personnel from USEPA, USDOT, and state and local agencies with expertise in the acquisition and reduction of ambient data.

Products

- Specifications for "bare bones" (minimum expense) mobile laboratory package for transportation air quality data acquisition, including development of any new, low-cost instrumentation needed.
- Suitably instrumented central test facility sites to which state agencies can come for specialized data needs.
- Standard sets of calibration data in ready-to-use, computerized tabulations.
- A report recommending any desirable changes in the siting of new and/or relocated CAMS monitors.
- Guidelines for states to develop own monitoring programs.

Recommendation 3.e: Improved Mobile-Source Emission Factors

Statement of the Problem

Much has already been said above about the need for improved procedures for calculating emissions from mobile sources (vehicles). Without repeating previous arguments, it should be emphasized here that this need is even more critical in project studies than in system analysis.

Two distinct classes of problems are perceived with respect to the current procedure favored by EPA which is called AP-42 Supplement 8. First, the Supplement 8 factors are derived (as were previous Supplements) from a standardized "Federal Test Procedure" developed by EPA which contains a

fixed pattern of accelerations, decelerations, cruise, and idling periods. This pattern is felt by some to be unrepresentative of driving conditions on some facility types, especially freeways, leading to gross overpredictions of emissions in some cases and consequent unnecessary concern over false predictions of violations of ambient air quality standards.

This is of more concern in project than in system analyses since in a system problem the number of individual links under consideration is usually very large and there is at least a chance that when results are summed over an entire network there will be both underpredictions of emissions from congested surface streets and overpredictions of emissions from free-flowing traffic when the FTP is used resulting in overall system predictions which may not be too far off the mark. This kind of internal cancellation of errors is much less likely in project analyses where only those few street links in the immediate corridor are studied. Since the freeway will normally carry most of the traffic in the corridor, any overprediction of its contribution to total emissions will likely dominate the analysis. This has been an increasingly severe problem as successive revisions of AP-42 procedures have increased unit emission rates by as much as a factor of 10 as additional variables are included in the calculational procedures. Where an overprediction formerly may not have made much difference with respect to violations of standards, now the per-vehicle emission rates are forecast at such high levels that even a small overprediction may lead to false estimates of violations.

The second problem is that even if these basic emission rates were not in dispute over their scientific validity, their application to actual air quality planning and analysis is rendered extremely difficult by their mathematical formulation and input data requirements. In Supplement 8, correction factors for vehicle speed, ambient temperature, and hot/cold engine conditions are presented by difficult to compute formulas rather than as straight-forward tabular or graphic look-ups. They also require as inputs traffic and vehicle classification data at a level of detail which is simply beyond the capabilities of many states' traffic forecasting systems. Especially problematical is the requirement for data on vehicle classification in terms of many categories of light and heavy duty vehicles which are not normally accounted for separately in transportation planning and for which, therefore, no forecasting techniques beyond the "educated guess" exist.

As mentioned elsewhere, extreme difficulties are caused for "user" agencies by EPA's insistence on the promulgation and enforced use of these factors while FHWA still retains serious scientific reservations about them. The emission factor controversy holds promise of becoming the outstanding example of the deleterious effect upon client agencies of disagreements between the responsible Federal organizations. For this reason, a very high priority has been assigned in these recommendations to the correction of this situation.

Objectives

USDOT and USEPA should immediately undertake a joint program to accomplish the following.

- Review the Supplement 8 emission factor computation method and settle outstanding questions as to its applicability to various types of driving cycle.
- Develop, if necessary, correction factors for Supplement 8 results to make them more accurately applicable to driving cycles which differ substantially from the Federal Test Procedure.
- Prepare the results of this research for promulgation in a ready to use package including manuals and card decks for a canned computer program plus applications examples and simplified graphical or nomograph solutions usable for quick estimation purposes.
- Establish a joint technical committee to cooperate in the development of the next cycle of revisions to AP-42 with emphasis on ensuring that the model is limited to reasonable input data requirements, ensuring that calculational procedures are as simple as is consistent with accuracy, and ensuring that the final product for promulgation is packaged in such a manner as to make it directly usable by client agencies with a minimum investment of resources.

Steering and Review Committee

Experts on modeling of emissions, drawn from USEPA, USDOT and appropriate state and local agencies.

Products

- A report presenting the results of the review of the applicability of Supplement 8 as issued.
- A report presenting calibration factors to increase the accuracy of Supplement 8 factors when applied in cases where driving cycles will differ substantially from the Federal Test Procedure.
- A report presenting administrative and organizational recommendations for establishment of an improved, joint EPA-DOT process for development and promulgation of future AP-42 revisions.

4. *POLICY ALTERNATIVES TASK-RELATED RESEARCH RECOMMENDATIONS*

The following recommendations grew out of the discussions which took place at the policy alternatives sessions of the workshops. The emphasis proved to be more on decision making processes and clarification of goals and objectives rather than on the kind of "hard technology" involved in the last previous recommendations.

Recommendation 4.a: Develop New Methodologies for Integrated and Comprehensive Analysis

Statement of the Problem

Participants in the workshops were in substantial agreement that there is much room for improvement in available tools for analyzing the trade-offs involved in simultaneous consideration of concerns of air quality, transportation, land use, and energy. Of particular concern was the cause/effect relationship between changes in transportation infrastructure and changes in land use.

During the early 1970s, some interesting research was supported by USDOT and CEQ on the effect of transportation supply on urban form and the consequent air quality impacts. That work concluded that there could be derived some optimum land-use patterns and transportation networks to serve them which would minimize emissions of air pollutants.

The research referred to was purely theoretical, working with arbitrary urban forms. It would be potentially valuable to continue the work on this optimization, both theoretically and on a case-study basis, and adding additional parameters such as minimization of energy consumption. The desired output would be a series of planning guidelines or principles for at least qualitatively estimating the response of land use and travel demand to transportation supply, and vice versa, and the consequent air quality and energy impacts. It may be possible to refine and extend the initial work in defining the optimum urban land-use arrangements and transportation networks to minimize these impacts. Possibly alternative optimal arrangements

can be developed under typical external constraints, e.g., radial development from a point as in plains cities, one-sided development as in coastal cities, elongated development as in closely related city pairs, etc. Successful development of solutions to this type of optimization problem could result in guidelines for land use planning which would be of immense importance and benefit. Conversely, transportation planning decisions could be made within the same guidelines to reinforce the desired development patterns.

As a final step, the principles developed by this research might by synthesized into new or existing land-use forecasting and transportation planning models to provide elected decision makers and their supporting staff better tools to analyze the results of policy decisions.

Objectives

- Develop a technical methodology optimizing the air quality and energy impacts of alternative transportation and land use arrangements.
- Develop a technical methodology for analyzing the growth inducing effect of changes in the transportation infrastructure in an urban area.
- (Both of these objectives will be further guided by the joint statement of issues developed under Recommendation I.b for generic research on the integration and coordination of Federal programs.)

Steering and Review Committee

The same group recommended under Recommendation I.b.

Product

- A report presenting guidelines for the optimization of land use and development, and the supporting transportation network for typical urban forms.
- A report presenting results enabling a user to estimate the economic growth inducing effect of transportation programs and investments of varying magnitude and nature.

Recommendation 4.b: Integration and Coordination of Goals and Policies

Statement of the Problem

State and local transportation agencies are critical of lack of sufficient policy guidance and coordination on the part of Federal agencies. Lack of such guidance makes it very difficult for transportation planners to factor into their projections and proposals adequate consideration of such items as impending energy shortages and other factors which may influence national transportation policy, with consequent secondary changes in environmental impacts of transportation systems.

There is increasing need for a research study which would synthesize current research into alternative transportation policies into a series of guidelines for reasonable assumptions regarding future national transportation policies and transportation and energy supply scenarios. To the extent that these guidelines show a future which differs markedly from the present, there would be increasingly great changes in projections of environmental quality impacts, even possibly to the point of influencing different transportation system development decisions.

Outside USDOT, there is need for codification of the goals and policies of other associated agencies, notably EPA and the Department of Energy, and their rationalization and coordination with DOT's policies and guidelines. Indeed the three agencies' policies are necessarily highly interactive, since ultimately the nature of the transportation system is shaped by the availability of fuel. The rate of consumption of fuel and consequent energy supply decisions are conversely strongly influenced by the nature of transportation decisions, while both energy supplies and transportation systems impact heavily on the environment and conversely have their nature shaped and influenced by environmental factors through the Environment Impact Statement review process. Therefore, for the three agencies to continue to pursue independent courses in setting policy and choosing desired future scenarios is not only undesirable but actually counter-productive to the needs of the state and local agencies with line

responsibility for transportation system planning and development.

Objectives

- Synthesize existing and ongoing USDOT policy studies into a systematic set of guidelines for reasonable assumptions regarding future transportation development scenarios. This should include such factors as energy supply, vehicle characteristics, highway vs. transit investment strategies, etc.
- Compile, to the extent available, goals statements and policy studies of other related Federal agencies, especially USEPA and DOE. Determine their impact upon the DOT scenarios developed under the previous objective. Where serious conflicts become evident, make recommendations for compromise policy/goals revisions.

Steering and Review Committee

Key policy making and support staff personnel from Federal agencies such as USDOT, USEPA, and the USDOE with some representation from state and local transportation planning agencies.

Product

- A report presenting guidelines for future transportation planning scenarios in terms of the parameters discussed under Objectives above.
- A report presenting, and analyzing the influence of, policies and goals of related agencies. Major conflicts with USDOT policies should be identified and reasonable compromises proposed where feasible.

Recommendation 4.c: Public Education on Transportation Policy

This recommendation is analogous to that made above under item 2.d. The only difference is the relatively subtle one that the issues which would be the subject of public education under 2.d would be designed to directly address the problem of linking transportation policy to public health questions

while here the effort would be broader in scope, educating the public as to the "why" of certain decisions in terms of additional parameters, both environmental and otherwise, such as energy consumption, land use patterns, etc. Indeed, although the recommendation is treated separately here because it arose separately in the policy-related workshop subgroups, it could easily be integrated into a single effort with that proposed under 2.d. Virtually all details would be the same.

CONCLUDING COMMENTS

The recommendations above have been presented in as individual a manner as is feasible so that each can be considered independently on its merits in the further development of the USDOT research program. In attempting to integrate them and consider the overall aspects, however, the following points may prove of some use to DOT management.

1. Resolution of Significant Problems

Three significant problems arose at each of the workshops that must be addressed by any USDOT air quality R & D effort, even though their full solution would require a much broader-based effort by non-research oriented USDOT elements and by other Federal agencies. These problems cut across jurisdictional lines, affect the different levels of transportation/air quality decision making (systems, project, policy) and have a direct bearing upon the efficacy of the workshop participants' agencies in meeting their environmental responsibilities. They are addressed in Parts II and III but in summary they are:

- The methodology and technology available to measure and forecast the impact of transportation alternatives on air quality, and subsequently to improve air quality, is grossly deficient as a basis for rational decision making;
- Effective lines of communication do not exist between Federal agencies and between Federal agencies and state and local agencies dealing with air quality issues, except in rare instances; and
- Any Federally-implemented program(s) to support the improvement of air quality, especially those based upon the recommendations of Parts II and III of this report, should be based upon regular and frequent contact and input from state and local departments of transportation and environmental protection.

2. Integration of Recommendations

Because of the manner in which the workshops were conducted, with separate sessions on system, project, and policy-related matters, it is inevitable that some of the basic topics of concern, such as air quality modeling, would be fragmented into several independent recommendations for research. It, therefore, seems appropriate to reemphasize that these larger problems must be considered as single issues if a rational research program is to be constructed. Specifically the reader's attention is directed again to the Table on page III-5 at the conclusion of the introduction to Part III. This presents at a glance the relationship of each individual research recommendation to the list of major issues developed under the "National Issues" discussion of Part II. Reading across any line of the Table gives, at a glance, the total spectrum of research suggested by workshop participants as being of pertinence to that issue.

3. A National Air Quality Modeling Center

The suggestion was made by several participants in the workshops that the most effective way to carry out the comprehensive air quality modeling program (Recommendations 1.a, 2.a, 2.b, 3.a, and some aspects of 3.d and 3.e) would be through the establishment of a national air quality modeling center. This would be manned by personnel seconded from USDOT, USEPA, and possibly other agencies and would be jointly funded. It would be charged with the responsibility for managing a national aerometric monitoring experimental facility called for in 3.d and run the information dissemination clearinghouse called for in 3.b A properly selected staff could make contributions to research called for in several other areas, most importantly Recommendations 2.c, 2.e, and 3.c.

In order to be of maximum use, such a center would have to be jointly funded and directed by USDOT and USEPA and would have to be accepted by both agencies as their ultimate technical resource for the resolution of questions of

transportation/air quality modeling. If this could be achieved, the contributions which such a facility could make to the resolution of problems in this technical field would be immense. It is urged that DOT management accept the workshop participants' recommendation that this is an idea worth pursuing and immediately begin an administrative investigation of its feasibility.

APPENDIX A

SUMMARIES OF WORKSHOP PROCEEDINGS

Introduction

Workshop Format

Each of the four workshops was identical in format. In the morning, participants were asked to divide into small group discussions dealing with project analysis, systems analysis, and alternative policy decisions. In each small group setting, non-Federal discussion leaders helped the participants examine the serious problems affecting their respective areas and consider what assistance is needed to address these problems. Each small group session was between 2 and 2 1/2 hours in length. Following lunch, the small group discussion leaders reported on their group's findings to the full meeting, giving everyone an opportunity to ask questions, offer criticisms, and suggest additions. The concluding session, also moderated by a non-Federal official, attempted to summarize the major technological assistance needs that were mentioned and focus discussion on other assistance needs that should be provided.

Preparation of Summaries

This section reviews the problems and assistance needs discussed by participants of the four workshops. The analysis is based upon a summary report that was prepared following each workshop. In most cases, the summary report was prepared by a workshop participant based upon his attendance at the workshop and his listening to the discussion leader reports at the afternoon session.

In order to ensure that these summaries were truly reflective of the most important issues mentioned by participants, each summary was submitted to six workshop participants for their review and comment; their suggestions and observations are incorporated into this final report. In addition, in preparation of the summaries, the full transcripts for each workshop's

small group sessions were carefully reviewed to pick up any additional items not covered by discussion leaders in their afternoon summaries.

Transcripts

Unfortunately, space does not permit provision of detailed examples which help explain the problems mentioned. However, these examples, and the full texts of the small group discussions, are contained in the workshop transcripts which the reader may wish to obtain for further clarification. These are available from the New England Municipal Center for the cost of reproduction.

Summary Content

Each regional summary is preceded by the name and title of the discussion leaders who played an essential role in helping the small groups focus on the most critical issues. It should be noted, however, that the summaries do not necessarily reflect the personal opinions of the discussion leaders, but rather the opinions of the group they moderated.

Sample Agenda

9:00 a.m.	REGISTRATION AND COFFEE
9:30 a.m.	INTRODUCTION AND WELCOME
	Office of the Secretary U.S. Department of Transportation Washington, D.C.
9:45 a.m.	SMALL GROUP ISSUE DISCUSSION
	Group A: Systems Analysis
	Group B: Project Analysis
	Group C: Alternative Policy Decisions
12:30 p.m.	LUNCHEON
1:30 p.m.	GENERAL SESSION
	Each discussion leader will present the most important problems their group identified, and will respond to questions by other participants.
3:00 p.m.	TECHNOLOGICAL ASSISTANCE: WHAT'S NEEDED?
	General discussion of specific technological assistance participants need to address the problems identified earlier.
4:00 p.m.	ADJOURNMENT

TRANSPORTATION-AIR QUALITY PROBLEMS AND ASSISTANCE NEEDS

NORTHEASTERN UNITED STATES REGIONAL ANALYSIS

(Based on opinions of officials who attended the Workshop on April 6, 1977 in Cambridge, Massachusetts.)

Small Group Discussion Leaders

Systems Analysis

Robert Kochanowski
Southwestern Pennsylvania
Regional Planning Commission
Pittsburgh, Pennsylvania

Alternative Policy Decisions

John H. Gastler
State Department of Transportation
Wethersfield, Connecticut

Project Analysis

Fedele Palmieri
State Department of Transportation
Albany, New York

Concluding Session Moderator

Matthew A. Coogan
State Executive Office of
Transportation and Construction
Boston, Massachusetts

MAJOR PROBLEMS

Systems Analysis

1. The scientific validity of the national air quality standards has not been adequately substantiated. The time tables and strategies proposed to attain air quality standards have often confused the public. This has had a debilitating impact on the progress of the air quality program.

2. The general public is, for the most part, not aware of the negative consequences of unhealthy levels of air quality, what the objectives are in air quality planning, and they are not convinced of the compelling need for daily sacrifices to attain national air quality standards.

3. Existing air quality models are insufficient to the task of projecting air quality impacts and measuring air quality levels. The rollback techniques applied to most of the more simplistic air quality models do not do an adequate job of assessing the interrelationship between vehicle miles traveled (VMT) and ambient air quality standards.

4. The promulgated control strategies, in many cases, are insensitive to VMT. In other cases it is difficult to determine the impact of a proposed strategy on air quality with any degree of accuracy. Variable emission rates, auto occupancy, future land use and development are all factors which are difficult to build into any impact assessment model.

5. Current background data is inaccurate. Present methods of collecting accurate vehicular miles of travel in the overall system by subarea unit and region are inadequate. Moreover, the decision of which geographic areas constitute the VMT that influences specifically defined air quality problems is arbitrary and without a substantive basis.

Project Analysis

1. Current vehicular emission factors lack adequate substantiation. There is a great deal of statistical error inherent in most of the numbers currently generated. Further, the standard Federal Test Procedure (FTP) is not representative of freeway driving cycles, and gives inappropriate results when FTP data is scaled up to freeway speeds.

2. Current dispersion models are inadequate. There is no central place where state and local officials can go for the validation and calibration of models. Even in cases where the model is calibrated, severe doubt exists as to whether the model itself is accurate. Further, when calibration data is not perfect, there is substantial likelihood that errors propagate throughout the equation. The Caline-2 and T-LINE models should be improved, and better models for special situations should be developed (e.g., area sources, queues, intersections, and especially street-canyons).

3. The present system for dissemination of information from Federal to state and local government officials is not working. The information in many cases is out of date before it arrives, and in many other situations, it simply isn't useful information.

4. Information disseminated to state and local officials from Federal agencies is not delivered in ready-to-use form. This problem is most poignantly illustrated by the recent dissemination of the Supplement 5 emission factors. State and local officials who are dependent on these kinds of data, models, and information, generally don't have the resources to put them on line.

5. Smaller states cannot afford the investment in data gathering required to determine background levels of pollutants and to calibrate more sophisticated dispersion models.

6. There are unreasonable delays in time in the transmission of data and information from Federal agencies to state and local governments.

7. Evaluation of project impacts relative to standards should be done in terms of statistical ranges and probabilities rather than arbitrary absolute numbers.

Policy Alternatives

1. Decision makers lack clear goals, policies and procedures for assessing environmental impacts which ultimately lead to decisions and commitments. Primary goals and priorities have not been adequately spelled out at the Federal level, and this creates a substantial amount of confusion for the local decision maker.

2. The Federal government must assist the state and local governments assess the impact of proposed transportation decisions, as they affect air quality, on public health, safety, energy and socio-economic characteristics.

3. There is a basic conflict between air quality goals and other competing goals at both the Federal and local levels. Local decision makers are often pushed by competing Federal agencies to pursue conflicting strategies. This creates confusion and a general lack of trust between Federal and state/local government decision makers.

4. Automobile pollution is clearly the most significant contributer to the pollution problem. Yet, there is tremendous resistance to change on the part of the public from the auto-dominated transportation system we have today.

5. Decision makers must consider not only the impact of their actions on local air quality, but also on the air quality of the entire region. This creates a substantial problem for some localities in a region. If one locality adopts stringent control strategies, it may do so at the expense of losing an industrial or commercial development. Conversely, it may adopt less stringent standards and find that the value of its taxable property decreases, or that the character of various neighborhoods change.

6. There is a general lack of public understanding of the measures required to abate air pollution problems in cities. Many times, negative public reaction to a proposed strategy - an exclusive bus lane, for example - can be attributed to the manner in which the proposal is presented to public decision makers.

ASSISTANCE NEEDS

1. Information on successful and unsuccessful air quality strategies should be gathered and disseminated to local officials to use when making transportation decisions in their area. It is particularly important for local officials to know what worked in one place and why it worked, how it could have worked better, why it failed, etc.

2. There is a tremendous need for the public to be educated on the benefits of good air quality, strategies required to attain national air standards in their area, the sacrifices they will individually be required to make in order to successfully achieve these objectives. Special attention must also be paid to the manner in which the public is approached about various control strategies to insure positive receptivity.

3. The national air quality standards must be better substantiated so that state and local officials feel more confident in presenting and defending them.

4. There is a great need for information to be disseminated in a timely, ready-to-use fashion to state and local officials. Models, in particular, should be further researched to assure their accuracy and precision. Models which require a burdensome level of input to make them operate should not be used. Existing models should be further refined and put in ready-to-use form for state and local officials.

5. Better and more complete background data must be gathered to insure accurate input into air quality models. A better monitoring strategy must be developed.

6. There is a need for a national, centralized research base for the validation and calibration of air quality models. Specifically, a Federal facility should be established for data acquisition, for model testing, and to assist in establishing guidelines for extrapolation or estimation of ambient levels.

7. The Federal government must reconcile major conflicts in national policy objectives before facing state and local governments to carry out various rules and regulations aimed at accomplishing one or the other of these objectives. The Federal agencies involved in air quality and transportation policy must give clearer and more uniform direction to states and localities as to which are primary goals, secondary goals, etc.

8. Research is needed to determine which combination(s) of incentives and discentives can be employed by Federal, state and local governments to impact the general public's decisions as they affect air pollution; e.g., how to encourage public use of carpooling, etc.

Other Assistance Needs

- DOT should assist EPA in establishing non-air quality impacts of pollution control decisions, and develop a state and sub-state mechanism to provide this information to governmental policy makers in a timely manner.

- In order to secure public understanding and subsequent support, air quality problems must be better researched and understood as to: (1) the overall consequences and benefits of improved air quality; (2) the relationship between ambient air quality and the areal and temporal distribution of pollutant emissions and meteorological conditions; and (3) the beneficial effect that specific pollutant emission reductions will have on ambient air quality.

- Additional research is needed to define the relationship between daily vehicular emissions and ambient air quality for photochemical pollutants. In particular, the scale of definitions for measuring both parameters needs a more meaningful definition. Good air quality simulation models must replace rollback techniques.

- Much more analysis needs to be conducted on the sensitivity of various types of transportation control strategies to total emissions across a meaningful air quality region. Total VMT (and hence emissions) in an area are most influenced by factors such as total forecasted travel demand, trip length, auto occupancy and vehicle emission rates, and to a much lesser degree by achievable shifts in travel mode or selected vehicular restraint strategies.

TRANSPORTATION-AIR QUALITY PROBLEMS AND ASSISTANCE NEEDS

SOUTHEASTERN UNITED STATES REGIONAL ANALYSIS

(Based on opinions of officials who attended the Workshop on May 4, 1977 in Atlanta, Georgia.)

Small Group Discussion Leaders

Systems Analysis

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Concluding Session Moderator

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MAJOR PROBLEMS

Systems Analysis

1. Uncertainty exists regarding the validity of models and modeling concepts used to evaluate the system-wide air pollution impact of various transportation alternatives. Insufficient information is disseminated relative to the state of the art of air quality modeling.

2. It is difficult to adequately determine whether increased emissions bring about increased concentrations of air pollution in an area.

3. The present SAPOLLUTT model is inadequate with respect to the supplement five emission factors - and will be even more out of date with regard to the supplement eight emission factors when they are issued later this year.

4. There is a major conflict between the role of the air pollution agency and the role of the transportation agency. This conflict produces confusion among the various agency personnel, can delay projects unnecessarily, and can create a general lack of public confidence in both types of agencies.

5. There is a problem in many areas with the Environmental Overview Statement being duplicative of ongoing individual project analyses/reviews, especially when a particular project comprises a substantial part of the overall transportation system of the area.

6. TSM elements currently are not oriented enough toward air quality; and if they (TSM elements) should be more oriented toward air quality, is it possible or valid to quantify the air quality effects of these elements.

Project Analysis

1. There is no reliable method for determining the regional or areawide effect of a particular project on photochemical oxidants. This is becoming a critical problem in nonattainment areas where projects must show a net reduction in emissions for the project area when the areawide concentration or ambient air quality may not be affected by this emission factor at all. There is a special need to determine the relationship of hydrocarbons to photochemical oxidants both on project and regional levels.

2. The total emissions may not be the valid factor to use when determining the oxidant concentration of an area, especially if vehicle speed and other transportation improvement factors are considered in the equation.

3. There are no diffusion models adequate to determine whether nitrogen oxides or hydrocarbons contribute most to the photochemical oxidant problem in the area.

4. There is no satisfactory model to predict ambient concentrations of oxidants.

5. There is a gross deficiency in ambient air background data on which to base models for computing projected concentrations on project and system-wide areas. Part of this problem can be attributed to the lack of a sufficient number of monitoring stations within an area, to the location of the stations, and to the cost of installing and maintaining them.

6. There is a lack of understanding of the strengths and weaknesses of various predictive models, vis meteorological conditions, population density, etc. Many of the models are not reliable for a particular area - depending on various conditions - and this seriously undermines public confidence in air quality/transportation strategies.

7. There is a problem identifying the air quality impact of CO trapped in covered and underground roads and freeways. Not enough study has gone into determining the maximum extent to which highways may be covered with long decks and still meet NAAGS without forced ventilation.

Other Issues Discussed

- Traffic engineers and air quality analysts do not talk the same language or use the same parameters to carry out problem analysis.

Policy Alternatives

1. The public is not fully educated about the air pollution and transportation problems and strategies. This lack of education produces a lack of public acceptance of transportation and air quality plans - especially those components which alter the way in which individuals currently carry out their daily lives.

2. The automobile is the most significant polluter in major urban areas. Not enough is being done to increase the fuel and pollution efficiency.

3. In order to reduce the number of vehicle miles traveled, incentives must be provided to citizens to use mass transit facilities, and disincentives must be instituted which discourage the use of the automobile. Political acceptance of the various disincentives - parking management plans, bus lanes, mandatory carpooling, parking surcharges - is lacking.

4. Federal, state and local agencies often work at cross purposes with each other. Most importantly, agencies within the Federal government appear to be working against each other to the eventual detriment of the state and local governments they interact with. Complicating this problem even further is a general communication problem.

5. Not enough emphasis is placed by the Federal government motor vehicle inspection and maintenance programs on a strategy for abating pollution.

6. Not enough attention is being focused on weighing air quality values and benefits against other competing variables such as economic development, energy conservation, land use and growth.

ASSISTANCE NEEDS

1. Considerable additional documentation is needed to substantiate the validity of various models currently in use.

2. Additional research is needed into the entire oxidant problem. Included in such a research agenda should be the relationship of various pollutants to the creation of photochemical oxidants in a region, the movement of photochemical oxidants within a region and between regions, and the microscale impacts of excessive levels of oxidants in regional and project areas.

3. Research and guidance in determining the level of CO background in certain areas is needed.

4. Policy analysis studies are needed to provide guidance to local agencies as to which are the most cost effective control measures.

5. Statistical analysis and research is needed to factor down the series of "worst case" conditions which local agencies use to predict the impact of various strategies on the air quality. This presumably would provide a more accurate yardstick against which to measure policy strategy decisions.

6. There is a need for additional financial assistance at the local level to supplement air quality and transportation planning, implementation and monitoring.

7. There is a need for public education programs on air quality and transportation to be developed at the local level. This will bring about understanding of various actions by citizens in the area, and gain greater public acceptance for major projects.

8. Research should be performed to determine the air quality impact on a region and on a project area of non-forced air ventilated tunnels (covered highways).

9. Research should be done into the problem of particulates reentrained from streets and vehicles. Research should be focused on the question of how this affects the ambient air quality of an area, and potential strategies for reducing the impact of the problem.

10. Dispersion factors currently being used in many of the microscale models should be evaluated. The factors were developed based on a series of experiments conducted several years ago and are insufficient to satisfy today's monitoring and modeling requirements.

11. An evaluation should be done and made available to local officials on the strengths and weaknesses of various predictive models. The research should focus on which of the models are best suited for particular meteorological, climatological and population density situations.

12. Local officials are in need of pertinent, cohesive, and understandable information disseminated to them in a regular and timely fashion.

Other Assistance Needs

- The distinction between urban weather and airport weather as it relates to air quality should be researched and reported.

- There is a need for measures to be established to determine the cost effectiveness of different control techniques.

- There is a need to find other than transportation operations control methods to reduce oxidants.

- Research is needed to assist EPA find the proper relationship between hydrocarbons and oxidants (i.e., Are the promulgated guidelines really carrying out the intent of the Clean Air Act?).

- Research is needed to determine how many continuous samplers are needed to define background profiles.

- Methods are needed to control hot spots and address the following questions: What effect will various levels of technique application have on the problem? Could areawide modeling be used to test the effectiveness of individual techniques (and insure that one solution does not simply move the problem to another area).

TRANSPORTATION-AIR QUALITY PROBLEMS AND ASSISTANCE NEEDS

CENTRAL UNITED STATES REGIONAL ANALYSIS

(Based upon opinions of officials who attended Workshop on June 1, 1977 in Kansas City, Missouri.)

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MAJOR PROBLEMS

Systems Analysis

1. There is a lack of public and political awareness of the magnitude of the problem. The lack of citizen input and involvement has resulted in little or no pressures being brought to bear upon legislators, which in turn results in low levels of funding.

2. A nationwide index, primarily related to human health, should be developed to help illustrate the gravity of the problems associated with deteriorating air quality. This index should be so established that lay persons can comprehend it. This would be useful to those attempting to counter automobile and highway interests.

3. Transportation Systems Management (TSM) strategies should be evaluated for their impact upon air quality.

4. There is a need for a review of the role that modeling plays in alternative analyses and for a reassessment of decision making criteria.

5. The means for integrating consideration of air quality planning into Comprehensive Systems Planning should be investigated. The relationship of air quality to transportation, land use and water needs to be addressed.

6. The inputs to models need to be examined, including the inventory process.

7. The 'Green Book' should be updated. A cookbook type process or manual should be developed to indicate what can be used in various communities.

8. An investigation is needed of the relationship between air quality and energy. Are the two issues at cross purposes? Do they complement one another?

Other Issues Discussed

- With the exception of densely populated areas, personnel in the MPOs tend to have little knowledge of environmental needs or methods; hence, they fail to properly support data needs for annual transportation plan/SIP consistency determination.

- Transportation data generated in the metropolitan areas, though probably suitable for non-environmental use, is not generally valid for network or sub-network environmental applications.

Project Analysis

1. There is a need for criteria to be developed which indicates the appropriate models to use in different types of areas. Special concern was voiced for the correct or best model to use in rural areas. The question of when one implements what level of analytical detail was raised.

2. Different models give different results at the same locations when reviewing the same conditions. The tools used in project analyses need to be refined or completely overhauled. Some models may have errors of 50 percent, yet are used.

3. It is difficult to test air quality conditions at the many sites that need to be tested. In one state, it was pointed out that the majority of testing equipment is permanently positioned.

4. There is a definite need for concurrence on techniques used and acceptable to both EPA and DOT.

5. Present techniques for forecasting traffic are inadequate because there is little or no anticipation of alternative energy availability in the future.

Other Issues Discussed

- A check on the accuracy (precision) of the models is needed. How accurate should we be with vph, speeds, auto mix, wind speeds and direction, background (extended to future years, time of year, and monitoring and historic data), etc. to get the desired output accuracy?

- Standardized methods for project level analysis for HC and NO_x analysis have not been provided.

Policy Alternatives

1. Local policy options are constrained by the ways in which existing Federal laws and regulations are constructed and administered. Bureaucratic operations add to this.

2. There is confusion because of the multitude of Federal and state agencies involved and the resultant differences in interpretation.

3. At the local level, the development of air quality plans is not a predominant concern. The aim is only to satisfy Federal or state guidelines. What we are observing are poor intergovernmental relations.

4. During the implementation process, Federal and state regulations create conflicts between and within agencies. Communication problems exist in too many places too often.

5. People at staff level frequently do not follow administrative procedures. Lack of familiarity with the procedures leads to lack of communications, which in turn mires the planning process and unduly hinders projects.

6. When Federal involvement in the project occurs, it generally occurs at a point which requires review functions, rather than helping establish the project on firm ground. As a result, there is a feeling of Monday morning quarterbacking going on on the part of the Federal officials, leading to unnecessary hostility.

7. There was the feeling that USDOT has not communicated clearly what it wants and really expects with regard to air quality planning.

Other Issues Discussed

- A decision and/or acknowledgement is needed that the National Ambient Air Quality Standards do not apply to OSHA-responsible locations. Application of NAAQS carbon monoxide levels to service stations, with respect to those who work there, would result in thousands of additional locations being designated as non-complying.

- Consistency is needed regarding the definition of pollutant background levels, particularly for carbon monoxide.

- DOT and others should make clear that the oxidants problem at a given site is primarily due to sources two to six hours upwind rather than local sources. Acceptance of this fact would obviate the need for HC and NO_x analyses at many locations.

ASSISTANCE NEEDS

The major themes that emerged from the Kansas City sessions were more software in nature and approach. Technology was accepted to include more than models, computers and numbers. The solution to air quality related transportation problems could be found in human relations, as well as in machines. The application of a series of key concepts to the modeling, experimentation and testing that is commonly accepted as research would go far in meeting the needs of local officials.

1. Simplification of what is already available. People feel that they are being inundated with procedures and tests of questionable validity. There is a genuine desire for the development of a manual which provides guidance to air quality research and monitoring. This manual should be prepared in a language that the layperson can understand. Furthermore, there is a need for materials to present to public officials and boards who are responsible for decision making, but who are unfamiliar with the field of air quality. It must get the message across that this issue is one of the most serious with which they must deal.

2. Standardize the analytical tools and methodologies. The same procedures should be used in similar locations across the nation. Problems do not recognize state or other jurisdictional boundaries. What applies to one metropolitan area must apply to all others of similar size.

3. Be consistent in the application of rules and regulations. Recognize individuality, but be internally consistent and apply the regulations fairly.

4. Educate the public as to the serious nature of the concern for air quality. The public includes the people at large, as well as the decision makers. Technical R & D has gone over the heads of the majority of people and therefore has a low priority. There is a need to clearly define and state the effects of air pollution in a manner which will convince local officials of the dangers.

5. Instead of a smooth functioning political process and productive intergovernmental relations, the practitioners in the field of air quality research find themselves amidst organizational chaos, disarray and jealousy. These problems must be worked on. Create interest and order where none exists.

6. There is a need for improved dissemination of data and information. This is needed by the uninitiated, the novice and the professional alike. Training sessions need to be developed, perhaps by the Federal agencies, to help identify the various roles the agencies involved have to play in the improvement of the quality of air. Related to this, there was a suggestion that a case study of interagency contacts and communications be undertaken.

7. Improvements to a validation of models, particularly those related to HC and NO_x. Improvements are needed at all phases of the testing, including training sessions and monitoring. Relations between FHWA and EPA need to be better coordinated.

8. The accuracy of data needs to be improved, including both air quality and traffic data. Practitioners felt that they were utilizing inadequate data of questionable validity for a particular site. Bad input produces bad output.

9. Control strategies need to be assessed. There was a feeling that no one was sure of what would work when they would be called upon to deal with an air pollution crisis. There is also the need to know more about the specific impacts of governmental actions to deal with crisis situations.

Other Needs Identified

- Simplified guidelines should be developed for use in the MPOs, spelling out personnel needs, data needs, and methodology for using the data. Such guidance should be concurred in by the EPA, and Federal funds should be provided to support the added personnel requirements.

- Acceptable simplified analysis techniques should be developed and promulgated, especially with respect to HC and NO_x analyses. Such techniques should be suitable for desk-top analysis with the aid of a calculator, and should not necessitate computer use except in densely populated areas.

- Emission factors for the pollutants of concern should be developed and disseminated in ready to use form rather than as given-undeveloped, in the EPA AP-42 supplements.

- Acceptable simplified data inputs for HC and NO_x total burden analysis should be concurred in by EPA and the fact of such concurrence made clear to state and local agencies. Methodologies should be kept simple and restricted to areas of reasonable need, not network-wide simply to give 'free' inventory and forecasts to interested agencies.

TRANSPORTATION-AIR QUALITY PROBLEMS AND ASSISTANCE NEEDS

WESTERN UNITED STATES REGIONAL ANALYSIS

(Based upon opinions of officials who attended Workshop on June 29, 1977 in Burlingame, California.)

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Concluding Session Moderator

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MAJOR PROBLEMS

Systems Analysis

1. Should urban form be addressed from the viewpoint of Government or from that of the citizen? How can changes in life style and urban form be implemented? Whose responsibility is such implementation?

2. Each area has specific needs and problems which cannot be met by a generalized air quality model. There is a need for making models area specific.

3. Reductions estimated for certain transportation control strategies often do not reflect what actually happens. This creates a "Credibility Gap".

4. Many times a policy board determines the desired action before all the facts are in. Analytical results are desired which will support this decision.

5. The "Consistency Assessment" requirement is interpreted differently by different review agencies. This sometimes amounts to "game playing". Coordination between agencies is needed.

6. Funding and ability to develop models is needed. Local and state agencies should be part of such development.

7. Modal split and transportation models were not designed to address air quality. The problems need to be identified and remedied.

8. The interface between transportation and air quality models needs to be improved. Disaggregation of transportation model outputs is needed to provide input to emissions models.

Other Issues Discussed:

.Subjectiveness of professional air quality and transportation planners/specialists working for State and MPO agencies is a serious problem and results in their inability to listen objectively to new information and communicate objectively with policy-makers.

.Techniques need to be developed to quantify emission changes due to transportation system changes, specifically, modal splits; e.g. What happens when you install a rail system? How does it effect vehicle emissions (reduce VMT)?, etc.

.Problem with the use and interpretation of air quality data, particularly data from several different sources; specifically, there is a problem in defining what the data represents and how it's used in transportation planning decisions.

Project Analysis

1. Emission factors should be more representative of actual conditions. Factors are needed to express what happens in queing, hot and cold starts, etc.

2. There is concern for the ability of traffic models to predict VMT, modal split, and temporal and spatial distribution. Traffic models should be calibrated and validated. Prediction of ramp metering effects is also needed.

3. Definition of background, or ambient, air quality is needed. Often, the 8-hour standard is exceeded during the late evening and early morning hours when vehicular activity is low. It is important to be able to assess the contribution of a roadway to these concentrations.

4. Much meteorological data exist which, at present, cannot be correlated to other sites. If a methodology existed, use could be made of these data.

5. Post project monitoring is needed for air quality and meteorology to assess the validity of our assumptions and the accuracy of our predictions.

6. Models should be identified, based upon their generic formulation. Assumptions inherent in the models and their limitations and applicability to certain types of situations should be identified. The application of physical models should be investigated.

7. It is difficult to determine the proper "Level of Effort" required for project analysis. Guidelines are needed.

8. How should the "worst case" situation be applied? How is it identified? How should the frequency of occurrence of a particular concentration be approached?

9. When an individual project is analyzed as part of a transportation system, differences between the build vs. no-build impacts are difficult to identify. This makes assessment of project alternatives tenuous at best.

10. Not enough has been done with regard to some pollutants such as particulates.

Other Issues Discussed:

.Problem exists in convincing the public that your data is valid and reflects potential impacts on air quality if certain actions are taken.

.There is a tremendous amount of unnecessary paperwork required of state DEQ's and DOT's to comply with Federal mandates, especially those resulting for inter-agency conflicts.

.Reevaluate the present methodologies that traffic planners use to support air quality considerations; e.g., information sought of traffic planners on a proposed freeway is obtained by the same methods that engineers use to decide how thick to make the pavement or how much of a curve to make, etc.

Policy Alternatives

1. It appears that some portions of the time frame for meeting the National Ambient Air Quality Standards are unrealistic. Recognition of technological, social, regional, and institutional constraints which would be area specific and pollutant specific would relieve frustration and encourage truthful reporting.

2. Cost effectiveness of transportation improvements and traffic control measures, as usually construed, is not as broad or as comprehensive an analysis as it should be. All social costs, especially energy, should be included and the time frame should

be long enough to include the effect of future scenarios. These measures need to be evaluated against stationary and areawide source control strategies.

3. DOT should be more honest in acknowledging its involvement in the air quality problem in its policy enactments. DOT should hold forum with EPA to discuss and resolve problems resulting from highway development.

4. The Federal decision making process seems to result in the adoption of regulations which are somewhat unrealistic with regard to the actual political world. Control regulations should be analyzed with respect to the possibility of implementation prior to being promulgated.

5. Federal policy should support strong land use controls at the local and regional level to achieve air quality and other desirable improvements.

6. There should be some gradual tools for assuring the implementation of control measures without decertifying an agency and thereby shutting down all activities on the basis of one project's problems.

7. Federal Agencies (FEA, EPA, DOT, HUD) need to coordinate their activities and promulgations to avoid the problems and frustrations of multiple "Masters" driving state and local agencies in many different directions.

8. The consistency determination process leaves much to be desired. Attention needs to be given to the entire process.

9. It would be useful to have a national clearinghouse to examine, develop, and improve air quality models, model calibration and monitoring methods. The information should be disseminated to the states on a regular basis.

10. Air quality maintenance areas often need to look beyond their own regions for solutions to their problems and to determine the effect of their policies on other areas. Federal policy, money, and authority are needed to pursue this.

Other Issues Discussed:

.Broad approach is necessary requiring that different kind of control devices in the engine be evaluated along with mode split options to determine the value of different trade-offs; related is the cost-effectiveness of various options and how politicians are brought into those considerations.

.What's needed is a total system approach to the air quality problems that incorporates all elements of a living environment in the final decision making process; this places air quality considerations next to land use, economic, and social considerations and necessarily requires a top-down approach from a policy perspective, e.g., the Federal government needs to take some initiative.

ASSISTANCE NEEDS

1. Compile a synthesis of information on the subject of the urban highway system and its influence on urban form. The synthesis should include material on induced growth and land use control. Candidate methods involving social and institutional avenues for land use control and methods for implementation should be suggested.

2. Develop a rationale for funding regional model development for specific regions. The rationale should include criteria for mode development to insure maximum utility of funds expended.

3. Develop a methodology for customizing general forms of air quality models to fit a particular area. The methodology should concentrate on those parameters which are found to be very site dependent.

4. Establish a methodology for post construction monitoring of air quality and meteorology to examine accuracy of predictions and effects of controls (e.g. transportation control strategies). The research study should recommend methods for funding such monitoring and should apply to projects as well as systems.

5. Review the art and science of emission factor development and make recommendations leading to a more orderly and predictable updating schedule.

6. Assess emission factor needs to describe special situations such as queing and cold and hot starts in actual situations. Investigate the possible advantages of using emissions per unit of operating time and make recommendations.

7. Survey existing transportation models with respect to suitability for interfacing with air quality and energy models. Produce a synthesis and make recommendations with special attention to those models which are efficient and whose output accuracy is commensurate with input needs and computation time.

8. Review the current research being done for NCHRP by Technology Service Corporation to statistically synthesize ambient air quality data bases from existing data. Recommend and undertake similar research, if reasonable, for the other pollutants.

9. Review the history of air quality analyses for transportation projects and the output in terms of level of effort and resources required. Conclusions should be drawn as to the adequacy.

10. Develop definitions and methodology for "worst case" analysis which are mutually satisfactory to the agencies involved.

11. Undertake a comprehensive review and development program for air quality modeling with emphasis on the following features:

    a) Interface between air quality and transportation models

    b) Demand for, and use of, inputs based on accuracy, availability, and sensitivity

    c) Balance between complexity, cost, and accuracy.

    d) Availability and representativeness of data bases for model validation

    e) Suitable dispersion parameters

    f) Accuracy of emission inventories

    g) Compatibility with EDP resources

12. Methodology to review and assess a data base for its suitability in model validation.

13. Develop a mechanism for policy direction which will assure the integration and compatibility of air quality, energy, transportation, and land use planning.

14. Produce a methodology for integrating "Future Research" into the air quality-transportation milieu.

15. Develop a cost-effectiveness methodology for assessing two strategies, mobile vs. stationary controls, which will take into account the total social cost with respect to future directions technology and society may take.

16. Study alternative processes and procedures for consistency determination and recommend changes which will be acceptable to local, state, and federal agencies.

17. Review and assess the availability and validity of models to predict land use changes based on changes in elements of the infrastructure such as transportation. Models should be policy sensitive. This task may include model development based on the outcome of the review. Recommendations should include avenues for implementation.

18. Develop policy methods for accepting gradual revisions in policy without totally disrupting the work through actions such as decertification.

19. Develop a study to provide implementable avenues of cooperation and coordination between such agencies as DOT-EPA, DOT-State Air Agency, and EPA-State Transportation Agency.

20. Develop ways to fund interregional studies involving pollutant transport.

21. Undertake an analysis of alternative urban forms and their effect on oxidant formation and concentrations.

22. Develop a program to educate the citizenry to the extent that the necessary changes in life style will be perceived and accepted and alternatives can be intelligently chosen.

APPENDIX B

TRANSPORTATION-AIR QUALITY WORKSHOP

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Atlanta, Georgia	May 4, 1977
Kansas City, Missouri	June 1, 1977
San Francisco, California	June 29, 1977

Note: Full addresses and telephone numbers are provided to facilitate continued exchange of information.

WORKSHOP FOR STATE, REGIONAL, AND LOCAL GOVERNMENT OFFICIALS
ON TRANSPORTATION-AIR QUALITY RESEARCH NEEDS

April 6, 1977

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