

US EPA ARCHIVE DOCUMENT

**REGULATORY IMPACT ANALYSES
FOR THE PARTICULATE MATTER
AND OZONE
NATIONAL AMBIENT AIR QUALITY STANDARDS
AND PROPOSED REGIONAL HAZE RULE**

Prepared by

**Innovative Strategies and Economics Group
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, N.C.**

July 17, 1997

TABLE OF CONTENTS

TABLE OF CONTENTS.....i

SELECTED LIST OF ACRONYMS.....vii

EXECUTIVE SUMMARY.....ES-1

1.0 INTRODUCTION AND OVERVIEW.....1-1

1.1 THE NATIONAL AIR QUALITY CHALLENGE.....1-2

1.2 OVERVIEW OF THE RIA METHODOLOGY.....1-6

1.3 KEY IMPROVEMENTS OVER THE PROPOSAL RIA’S.....1-10

1.4 KEY LIMITATIONS.....1-12

1.5 REFERENCES.....1-14

2.0 STATEMENT OF NEED FOR THE PROPOSED REGULATIONS.....2-1

2.1 INTRODUCTION.....2-1

2.2 STATUTORY AUTHORITY AND LEGISLATIVE REQUIREMENTS
FOR PM AND OZONE NAAQS, AND RH RULE.....2-1

2.3 AUTHORITY FOR THIS RIA.....2-4

2.4 KEY HEALTH AND WELFARE EFFECTS.....2-6

2.5 NEED FOR REGULATORY ACTION.....2-10

2.6 REFERENCES.....2-13

3.0 NAAQS AND RH ALTERNATIVES ASSESSED.....3-1

3.1 INTRODUCTION.....3-1

3.2 DESCRIPTIONS AND RATIONALES FOR STANDARDS
EVALUATED.....3-2

3.3 REFERENCES.....3-8

TABLE OF CONTENTS (continued)

4.0 BASELINE EMISSIONS AND AIR QUALITY.....4-1

4.1 RESULTS IN BRIEF.....4-1

4.2 INTRODUCTION.....4-2

4.3 ESTIMATION OF 1990 EMISSIONS AND 2010 EMISSIONS PROJECTIONS.....4-3

4.4 ESTIMATION OF BASELINE PM AIR QUALITY CONCENTRATIONS IN 2010.....4-26

4.5 ESTIMATION OF BASELINE OZONE AIR QUALITY CONCENTRATIONS IN 2010.....4-45

4.6 REFERENCES.....4-62

5.0 CONTROL MEASURES.....5-1

5.1 INTRODUCTION.....5-1

5.2 UTILITY POINT SOURCE CONTROL MEASURES.....5-4

5.3 NON-UTILITY STATIONARY POINT SOURCE CONTROL MEASURES.....5-8

5.4 STATIONARY AREA SOURCE CONTROL MEASURES.....5-9

5.5 MOBILE SOURCE CONTROL MEASURES.....5-9

5.6 ANALYTICAL UNCERTAINTIES, LIMITATIONS, AND POTENTIAL BIASES.....5-16

5.7 REFERENCES.....5-18

6.0 EMISSIONS, AIR QUALITY, AND COST IMPACTS OF PM_{2.5} ALTERNATIVES.....6-1

6.1 RESULTS IN BRIEF.....6-1

6.2 INTRODUCTION.....6-1

TABLE OF CONTENTS (continued)

6.3 EMISSIONS, AIR QUALITY, AND COST ANALYSIS
 METHODOLOGY.....6-2

6.4 EMISSION REDUCTION AND AIR QUALITY IMPACT RESULTS.....6-15

6.5 COST IMPACT RESULTS.....6-29

6.6 ESTIMATING PM_{2.5} IMPACTS AFTER ATTAINMENT OF AN
 ALTERNATIVE OZONE NAAQS..... 6-31

6.7 ANALYTICAL UNCERTAINTIES, LIMITATIONS, AND
 POTENTIAL BIASES..... 6-33

6.8 REFERENCES..... 6-34

7.0 EMISSION REDUCTION AND COST IMPACTS FOR OZONE
 ALTERNATIVES..... 7-1

7.1 RESULTS IN BRIEF.....7-1

7.2 INTRODUCTION..... 7-1

7.3 EMISSION REDUCTION AND COST IMPACT ANALYSIS
 METHODOLOGY..... 7-2

7.4 EMISSION REDUCTION IMPACT RESULTS.....7-8

7.5 COST IMPACT RESULTS..... 7-11

7.6 ESTIMATING OZONE IMPACTS AFTER ATTAINMENT OF
 AN ALTERNATIVE PM_{2.5} STANDARD..... 7-12

7.7 ANALYTICAL LIMITATIONS, UNCERTAINTIES, AND
 POTENTIAL BIASES..... 7-14

7.8 REFERENCES..... 7-15

8.0 VISIBILITY AND COST IMPACT ANALYSIS OF REGIONAL
 HAZE ALTERNATIVES..... 8-1

8.1 RESULTS IN BRIEF..... 8-1

TABLE OF CONTENTS (continued)

8.2 INTRODUCTION..... 8-2

8.3 COST ANALYSIS METHODOLOGY..... 8-3

8.5 VISIBILITY IMPROVEMENT RESULTS..... 8-12

8.6 COST ANALYSIS RESULTS..... 8-14

8.7 ANALYTICAL UNCERTAINTIES, LIMITATIONS, AND
POTENTIAL BIASES..... 8-15

8.8 REFERENCES..... 8-16

9.0 DISCUSSION OF FULL ATTAINMENT COSTS..... 9-1

9.1 RESULTS IN BRIEF..... 9-1

9.2 INTRODUCTION..... 9-2

9.3 METHODOLOGY AND RESULTS..... 9-5

9.4 THE ROLE OF NEW AND EMERGING TECHNOLOGY IN NAAQS
ATTAINMENT..... 9-12

9.5 TRENDS AND FACTORS LEADING TO MORE COST-EFFECTIVE
IMPLEMENTATION..... 9-17

9.6 REFERENCES..... 9-35

10.0 ADMINISTRATIVE BURDENS AND COSTS..... 10-1

10.1 INTRODUCTION..... 10-1

10.2 FORMAT..... 10-2

10.3 OZONE ADMINISTRATIVE BURDEN AND COST..... 10-12

10.4 PARTICULATE MATTER ADMINISTRATIVE BURDEN
AND COSTS..... 10-21

10.5 RH ADMINISTRATIVE BURDEN AND COSTS..... 10-24

TABLE OF CONTENTS (continued)

10.6 UNCERTAINTY..... 10-30

10.7 TOTAL BURDEN AND COSTS FOR THE JOINT OZONE/PM
NAAQS AND RH TARGET10-31

10.8 REFERENCES..... 10-33

11.0 ECONOMIC IMPACT ANALYSIS (EIA)..... 11-1

11.1 RESULTS IN BRIEF.....11-1

11.2 INTRODUCTION..... 11-2

11.3 KEY CHANGES IN THE ECONOMIC IMPACT ANALYSIS
FROM PROPOSAL RIA’S..... 11-4

11.4 SUMMARY OF AFFECTED INDUSTRIES..... 11-4

11.5 SCREENING ANALYSIS..... 11-7

11.6 UTILITY INDUSTRY IMPACTS.....11-13

11.7 ENVIRONMENTAL PROTECTION ACTIVITIES..... 11-18

11.8 QUALITATIVE MARKET IMPACTS ASSESSMENT.....11-20

11.9 SMALL ENTITY IMPACTS..... 11-23

11.10 GOVERNMENTAL ENTITIES ANALYSIS.....11-28

11.11 ENVIRONMENTAL JUSTICE..... 11-29

11.12 REFERENCES..... 11-30

12.0 BENEFITS OF NAAQS AND REGIONAL HAZE 12-1

12.1 RESULTS IN BRIEF..... 12-1

12.2 INTRODUCTION..... 12-1

12.3 UPDATES AND REFINEMENTS..... 12-2

TABLE OF CONTENTS (continued)

12.4 OVERVIEW OF THE BENEFITS ANALYSIS METHODOLOGY.....12-3

12.5 SCOPE OF ANALYSIS..... 12-20

12.6 ESTIMATION OF POST-CONTROL AIR QUALITY..... 12-21

12.7 HUMAN HEALTH EFFECTS.....12-29

12.8 WELFARE EFFECTS.....12-50

12.9 SUMMARY OF HEALTH AND WELFARE BENEFITS..... 12-64

12.10 ANALYTICAL UNCERTAINTIES, LIMITATIONS, AND BIASES.....12-71

12.11 REFERENCES..... 12-83

13.0 BENEFIT-COST COMPARISONS..... 13-1

13.1 RESULTS IN BRIEF.....13-1

13.2 INTRODUCTION..... 13-1

13.3 COMPARISONS OF BENEFITS TO COSTS..... 13-2

13.4 LIMITATIONS TO THE BENEFIT-COST COMPARISONS..... 13-6

13.5 SUMMARY.....13-7

APPENDIX A: ESTIMATION OF 1990 EMISSIONS BY MAJOR SECTOR..... A-1

A.1 ESTIMATION OF 1990 EMISSIONS BY MAJOR SECTOR..... A-2

A.2 BASE YEAR 1990 NATIONAL EMISSIONS ESTIMATES BY SOURCE
CATEGORY..... A-7

A.3 2010 CAA CONTROL ASSUMPTIONS BY MAJOR SECTOR.....A-10

A.4 2010 NATIONAL POST-CAA CONTROL EMISSIONS ESTIMATES BY
SOURCE CATEGORY.....A-13

A.5 OZONE REGRESSION EQUATION USED IN ROM EXTRAPOLATION

TABLE OF CONTENTS (continued)

METHODOLOGY..... A-16

APPENDIX B: SUMMARY OF CONTROL MEASURES IN THE PM,
REGIONAL HAZE, AND OZONE ANALYSES..... B-2

B.1 SUMMARY OF CONTROL MEASURES..... B-2

B.2 DOCUMENTATION OF CONTROL MEASURES BY SOURCE CATEGORY..... B-12

APPENDIX C: COSTS AND BENEFITS OF ACHIEVING THE CURRENT PM₁₀
AND OZONE STANDARDS..... C-1

1.0 CURRENT PM10 STANDARD RESULTS IN BRIEF..... C-2

2.0 CURRENT OZONE STANDARD RESULTS IN BRIEF..... C-2

3.0 INTRODUCTION..... C-3

4.0 ANALYSIS OF THE CURRENT PM10 STANDARD..... C-3

5.0 ANALYSIS OF THE CURRENT OZONE STANDARD..... C-8

6.0 ANALYTICAL UNCERTAINTIES, LIMITATIONS, AND POTENTIAL
BIASES..... C-12

APPENDIX D: CONTROL COST SENSITIVITY ANALYSES..... D-1

1.0 INTRODUCTION..... D-2

2.0 ALTERNATIVE COST PER TON CONTROL MEASURE SELECTION
THRESHOLDS IN THE OZONE COST ANALYSIS..... D-3

3.0 ALTERNATIVE DOLLAR PER MICROGRAM PER CUBIC METER
REDUCED CONTROL MEASURE SELECTION THRESHOLD IN THE
PM COST ANALYSIS..... D-5

4.0 ALL MONITORED COUNTY PM COST ANALYSIS..... D-10

5.0 FUGITIVE DUST ADJUSTMENT FACTOR IN THE PM COST ANALYSIS..... D-12

6.0 EMISSION REDUCTION, AIR QUALITY, AND COST IMPACT RESULTS
FOR THE PM2.5 15/50 ALTERNATIVE FOLLOWING THE 0.08 3rd MAX

TABLE OF CONTENTS (continued)

OZONE ALTERNATIVE..... D-16

7.0 EMISSION REDUCTION AND COST IMPACT RESULTS FOR
0.08 3rd MAX. OZONE ALTERNATIVE FOLLOWING THE
ALTERNATIVE PM2.5 15/50 STANDARD..... D-18

APPENDIX E: REGIONAL HAZE CALCULATION CONSTANTS..... E-1

1.0 INTRODUCTION..... E-2

2.0 CONCENTRATION AND RELATIVE HUMIDITY CONSTANTS..... E-2

3.0 AVERAGE ANNUAL 90TH-TO-50TH PERCENTILE
DECIVIEW VALUES..... E-10

4.0 REFERENCES..... E-12

APPENDIX F: ESTIMATION OF FULL ATTAINMENT COSTS..... F-1

F.1 EXAMPLES OF POTENTIAL CONTROL MEASURES MODELLED FOR
THE 2010 FULL ATTAINMENT SCENARIO..... F-2

F.2 EXAMPLES OF EMERGING TECHNOLOGIES FOR LOWER EMISSIONS
OR CHEAPER CONTROL OF VOCs, NOx, AND PM..... F-14

APPENDIX G: ADMINISTRATIVE BURDEN AND COSTS SUPPORTING
INFORMATION..... G-1

G.1 IDENTIFICATION OF MILITARY ESTABLISHMENTS AFFECTED BY
SELECTED NAAQS..... G-2

G.2 OZONE STANDARD ANALYSIS..... G-8

APPENDIX H: ECONOMIC IMPACTS SUPPORTING INFORMATION..... H-1

1.0 SUMMARY OF PROFILE OF AFFECTED INDUSTRIES..... H-2

2.0 OVERVIEW OF THE EP INDUSTRY I-O MODEL..... H-19

3.0 REFERENCES..... H-23

APPENDIX I: BENEFIT ANALYSIS SUPPORTING INFORMATION..... I-1

I.1 PARTICULATE MATTER HEALTH AND WELFARE EFFECTS ESTIMATION..... I-2

I.2 OZONE HEALTH AND WELFARE EFFECTS ESTIMATION.....I-8

I.3 VALUATION AND AGGREGATION.....I-13

I.4 SENSITIVITY ANALYSES.....I-25

I.5 OZONE BENEFITS USING CLINICAL STUDIES..... I-31

I.6 REFERENCES.....I-40

APPENDIX J: OZONE MORTALITY META-ANALYSIS.....J-1

J.1 ASSESSMENT AND SYNTHESIS OF AVAILABLE EPIDEMIOLOGICAL EVIDENCE OF MORTALITY ASSOCIATED WITH AMBIENT OZONE FROM DAILY TIME-SERIES ANALYSES.....J-2

1.0 OVERVIEW OF AVAILABLE LITERATURE.....J-2

2.0 SELECTION CRITERIA FOR QUANTITATIVE ANALYSIS..... J-19

3.0 SUMMARY OF SELECTED STUDIES..... J-26

4.0 QUANTITATIVE APPROACH.....J-31

5.0 REFERENCES..... J-38

J.2 POOLING THE RESULTS OF DIFFERENT STUDIES.....J-41

SELECTED LIST OF ACRONYMS

ACT	Alternative Control Techniques
AIRS	Aerometric Information Retrieval System
AIRCOST	utility SO ₂ control cost model (E.H.Pechan & Associates)
AF	air/fuel adjustment
ALAPCO	Association of Local Air Pollution Control Officers

AP-42	compilation of air pollutant emissions factors
AQSSD	Air Quality Strategies and Standards Division
AV	annualized value
BARCT	best available retrofit control technology
BEA	Bureau of Economic Analysis
BOOS	burners out-of-service
CAA	Clean Air Act
CAAAC	Clean Air Act Advisory Committee
CAM	Compliance Assurance Monitoring
CASAC	Clean Air Scientific Advisory Committee
CD	Criteria Document
CFC	chlorofluorocarbons
CFR	Code of Federal Regulations
CRDM	Climatological Regional Dispersion Model
CARB	California Air Resources Board
CARM	California Air Resources Management
CO	carbon monoxide
CS-C	control strategy-cost
CTG	control technique guideline
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
E.O.	Executive Order
EP	environmental protection
EPA	Environmental Protection Agency
EIA	Energy Information Administration
ERCAM	Emission Reductions and Cost Analysis Models
ERCAM NO _x	Enhancements to the Emission Reduction and Cost Analysis Models for NO _x
ERCAM VOC	Enhancements to the Emission Reduction and Cost Analysis Models for VOC
ESP	electrostatic precipitator
FAC	aerosol coefficients
FACA	Federal Advisory Committee Act
FGD	flue gas desulfurization
FGR	flue gas recirculation
FIP	Federal implementation plan
FLM	Federal Land Manager
FMVCP	Federal Motor Vehicle Control Program
FR	Federal Register
FTE	full time equivalent
GCVTC	Grand Canyon Visibility Transport Commission
GDP	gross domestic product
GNP	gross national product
GSP	gross State product

SELECTED LIST OF ACRONYMS (continued)

ICI	industrial, commercial, and institutional
ICR	Information Collection Request
ISCST	Industrial Source Complex Short Term
I/M	inspection/maintenance
I-O	input-output
IPM	Integrated Planning Model
IR	ignition timing retardation
LAER	lowest achievable emission rate
LEA	low excess air
LEV	low emission vehicle
LMOS	Lake Michigan Ozone Study Group
LNB	low-NO _x burner
MACT	maximum achievable control technology
MSA	metropolitan statistical area
MW	megawatts
NAAQS	national ambient air quality standards
NAMS	National Air Monitoring Stations
NAPAP	National Acid Precipitation Assessment Program
NAS	nonattainment areas
NEI	National Emissions Inventory
NH ₃	ammonia
NPV	net present value
NSR	New Source Review
NGR	natural gas recirculation
NO _x	oxides of nitrogen
NPI	National Particulate Inventory
NSCR	non-selective catalytic reduction
NSPS	New Source Performance Standard
O&M	operating and maintenance
OAQPS	Office of Air Quality Planning and Standards
OCS	outer continental shelf
OFA	overfire air
OMB	Office of Management and Budget
OMS	Office of Mobile Sources
OMTG	open market trading guidelines
OTAG	Ozone Transport Assessment Group
OTC	Ozone Transport Commission
OXYFIRING	firing of glass furnaces with oxygen-enriched combustion air
PAMS	Photochemical Assessment Monitoring Stations
PM	Particulate Matter
PRA	Paperwork Reduction Act
P-V valves	pressure-vacuum valves

SELECTED LIST OF ACRONYMS (continued)

RACT	reasonably available control technology
RADM	Regional Acid Deposition Model
RAMP	Regional Air Management Plan
REMI	Regional Economic Model
REMSAD	Regulatory Modeling System for Aerosols and Deposition
RFA	Regulatory Flexibility Analysis
RH	Regional Haze
RIA	Regulatory Impact Analysis
RIS	Regulatory Impact Statement
RNA	residual nonattainment area
ROM	Regional Oxidant Modeling
RVP	Reid Vapor Pressure
S-R	source-receptor
SBREFA	Small Business Regulatory Enforcement Fairness Act
SCAQMD	South Coast Air Quality Management District
SCC	Source Classification Code
SCR	selective catalytic reduction
SIC	Standard Industrial Classification
SIP	State implementation plan
SLAMS	State and Local Air Monitoring Stations
SNCR	selective non-catalytic reduction
SOA	secondary organic aerosols
SOCMI	Synthetic Organic Chemical Manufacturing Industry
SO ₂	sulfur dioxide
SO _x	sulfur oxides
SBA	Small Business Administration
SP	Staff Paper
SPMS	special purpose monitors
STAPPA	State and Territorial Air Pollution Program Administration
TAC	total annual costs
TCI	total capital investment
TSP	total suspended particulate
TVA	Tennessee Valley Authority
ULNB	ultra low-NO _x burner
UMRA	Unfunded Mandates Reform Act
USDA	U.S. Department of Agriculture
VOC	volatile organic compounds
VMT	vehicle miles traveled