



## U.S. Environmental Protection Agency

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[Recent Additions](#) | [Contact Us](#) | [Print Version](#) Search:

[EPA Home](#) > [Air & Radiation](#) > Benefits and Costs of the Clean Air Act

[Where You Live](#)

[Indoor Air](#)

[Transportation/Fuels](#)

[Off-road Equipment](#)

[Acid Rain](#)

[Ozone Depletion](#)

[Climate Change](#)

[Visibility](#)

[Toxic Air Pollutants](#)

[Radiation](#)

# Benefits and Costs of the Clean Air Act

## Final Report to Congress on Benefits and Costs of the Clean Air Act, 1990 to 2010

EPA 410-R-99-001

## Final Report to Congress on Benefits and Costs of the Clean Air Act, 1970 to 1990

EPA 410-R-97-002

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Throughout the history of the Clean Air Act, questions have been raised as to whether the health and environmental benefits of air pollution control justify the costs incurred by industry, taxpayers, and consumers. While the benefits and costs of individual programs and standards continue to be addressed through narrowly-focused regulatory analyses, there has never been a comprehensive, long-term, scientifically valid and reliable study which answered the broader question:

***"How do the overall health, welfare, ecological, and economic benefits of Clean Air Act programs compare to the costs of these programs?"***

To address this void, Congress added to the 1990 Clean Air Act Amendments a requirement under section 812 that EPA conduct periodic, scientifically reviewed studies to assess the benefits and the costs of the entire Clean Air Act.

On October 15, 1997, EPA issued the first in this series of reports, entitled "The Benefits and Costs of the Clean Air Act, 1970 to 1990", following completion of a six-year process of study development and outside expert review. The report shows that the public health protection and environmental benefits of the Clean Air Act exceeded the costs of its programs by a large margin.

On November 15, 1999, EPA issued the second in this series of reports, "The Benefits and Costs of the Clean Air Act, 1990 to 2010". This second study, the first of an ongoing series of prospective analyses, was also issued after a six-year process of study development and outside expert review. This first prospective study also finds that the benefits of the programs and standards required by the 1990 Clean Air Act Amendments significantly exceed costs.

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## **Prospective Study, 1990 to 2010**

### **[Press Release](#)**

**[Electronic Copy](#)**: Electronic copies of the full report, or individual technical appendices.

## **Retrospective Study, 1970 to 1990**

**[Study Design and Summary of Results](#)**: Detailed information on the study and its results.

**[Study Review](#)**: A description of the review process and a list of the distinguished scientists and economists who participated in the review of the study.

**[Electronic Copy](#)**: Electronic copies of the Abstract, Executive Summary, full report, or individual technical appendices.

To request paper copies of the report by mail, contact Barbara Morris by phone at 202-564-1666, or by fax at 202-564-1554.

For further technical information on either the retrospective report or the new prospective report, contact Jim DeMocker by phone at 202-564-1673 or by E-Mail at [democker.jim@epa.gov](mailto:democker.jim@epa.gov).

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[Frequently Asked Questions](#) | [Technical Information](#)

---

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# U.S. Environmental Protection Agency

Air & Radiation

[Recent Additions](#) | [Contact Us](#) | [Print Version](#) Search:

[EPA Home](#) > [Air & Radiation](#) > [Benefits and Costs of the Clean Air Act](#) > 1990 CLEAN AIR AMENDMENTS

## 1990 CLEAN AIR AMENDMENTS

[Where You Live](#)

[Indoor Air](#)

[Transportation/Fuels](#)

[Off-road Equipment](#)

[Acid Rain](#)

[Ozone Depletion](#)

[Climate Change](#)

[Visibility](#)

[Toxic Air Pollutants](#)

[Radiation](#)

---

**FOR RELEASE: TUESDAY, NOVEMBER 16, 1999**

**NEW REPORT SHOWS BENEFITS OF 1990 CLEAN AIR AMENDMENTS**

**OUTWEIGH COSTS BY FOUR-TO-ONE MARGIN**

**Dave Ryan 202-260-2981**

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The economic value of the public health and environmental benefits that Americans enjoy from the Clean Air Act Amendments of 1990 exceed their costs by a margin of four to one, according to a new EPA study. The report projects that the Clean Air Act Amendments and their associated programs prevent thousands of premature deaths related to air pollution, and millions of asthma attacks as well as a wide range of additional human health and ecological effects.

"This Administration has enacted the most stringent public health and environmental standards ever while creating unprecedented economic growth," said President Bill Clinton. "This report further demonstrates that public health and environmental benefits can be achieved along with economic benefits, and this Administration will continue to work aggressively to protect the air we breathe, the water we drink, and the land on which we live."

Using a sophisticated array of computer models and the latest emissions and cost data, the EPA study shows that in the year 2010 the Amendments of 1990 will prevent 23,000 Americans from dying prematurely, and avert over 1,700,000 incidences of asthma attacks and aggravation of chronic asthma. In addition, in 2010, they will prevent 67,000 incidences of chronic and acute bronchitis, 91,000 occurrences of shortness of breath, 4,100,000 lost work days, and 31,000,000 days in which Americans would have had to restrict activity due to air pollution related illness. Plus, 22,000 respiratory-related hospital admissions would be averted, as well as 42,000 cardiovascular (heart and blood) hospital admissions, and 4,800 emergency room visits for asthma.

The report, the most comprehensive and extensive assessment of the 1990 Clean Air Act Amendments ever conducted, was the subject of extensive peer

review during which independent panels of distinguished economists, scientists, and public health experts provided in-depth assessment and advice throughout the study's design, implementation, and documentation.

For those health and ecological benefits which could be quantified and converted to dollar values, EPA's best estimate is that in 2010 the benefits of Clean Air Act programs will total about \$110 billion. This estimate represents the value of avoiding increases in illness and premature death which would have prevailed without

-2-

the clean air standards and provisions required by the Amendments. By contrast, the detailed cost analysis conducted for this new study indicates that the costs of achieving these health and ecological benefits are likely to be only about \$27 billion, a fraction of the economic value of the benefits.

Today's report notes that beyond the quantified human health benefits, there are a wide range of additional human health and environmental benefits which scientists and economists cannot yet quantify and express in dollar terms. These include the control of cancer-causing air toxics as well as benefits to crops and ecosystems of reducing pollutants such as ozone and particulate matter.

The study released today is the second in a series of EPA cost/benefit Reports to Congress examining the effects of the Clean Air Act on the U.S. economy, public health, and the environment. The first study, a retrospective assessment released in October 1997, found that the benefits of 1970 to 1990 clean air programs greatly exceeded costs.

Today's prospective study is issued under Section 812 of the Clean Air Act Amendments, a provision requiring that EPA periodically assess the effect of the Clean Air Act on the public health, economy, and environment of the country. The report, "The Benefits and Costs of the Clean Air Act Amendments of 1990," will be available on the Internet at: <http://www.epa.gov/oar/sect812>. A limited number of paper copies of the report will be available from Barbara Morris at 202-564-1666 or by e-mail at [morris.barbara@epa.gov](mailto:morris.barbara@epa.gov). For further technical information, contact Jim Democker at 202-564-1673, or e-mail at: [democker.jim@epa.gov](mailto:democker.jim@epa.gov).

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[Frequently Asked Questions](#) | [Technical Information](#)

---

[EPA Home](#) | [Privacy and Security Notice](#) | [Contact Us](#)



# U.S. Environmental Protection Agency

Air & Radiation

[Recent Additions](#) | [Contact Us](#) | [Print Version](#) Search:

[EPA Home](#) > [Air & Radiation](#) > [Benefits and Costs of the Clean Air Act](#) > Electronic Copy

## Benefits and Costs of the Clean Air Act

[Where You Live](#)

[Indoor Air](#)

[Transportation/Fuels](#)

[Off-road Equipment](#)

[Acid Rain](#)

[Ozone Depletion](#)

[Climate Change](#)

[Visibility](#)

[Toxic Air Pollutants](#)

[Radiation](#)

## Electronic Copy

The report includes an Executive Summary which describes the study and its findings in more detail and nine technical appendices which provide in-depth documentation for each of the analytical components.

These report elements are available here in PDF format. After downloading the PDF file or files of interest, they can be read on screen or printed using the free Adobe(R) Acrobat(R) Reader. If you don't already have the Reader installed on your system you can [find out how to download it for free](#).

To download individual report components, click on the files below:

FILE	SIZE (KB)	DESCRIPTION
<a href="#">SAB Closure Letter</a>	3,072	SAB Peer Review Closure Letter
<a href="#">Full Report</a>	9,951	Full Report: Title page, Executive Summary, Table of Contents, Tables, Figures, Main Report Text (Chapters 1-8), Appendices A-I
<a href="#">Main Body</a>	1,183	Title page, Executive Summary, Table of Contents, Tables, Figures, Main Report Text (Chapters 1-8).
<a href="#">Appendix A</a>	860	Appendix A: Emissions Analysis
<a href="#">Appendix B</a>	731	Appendix B: Direct Costs
<a href="#">Appendix C</a>	2,490	Appendix C: Air Quality Modeling

<a href="#">Appendix D</a>	1,925	Appendix D: Human Health and Visibility Effects of Criteria Pollutants
<a href="#">Appendix E</a>	1,748	Appendix E: Ecological Effects of Criteria Pollutants
<a href="#">Appendix F</a>	255	Appendix F: Effects of Criteria Pollutants on Agriculture
<a href="#">Appendix G</a>	1,255	Appendix G: Stratospheric Ozone Assessment
<a href="#">Appendix H</a>	924	Appendix H: Valuation of Human Health and Welfare Effects of Criteria Pollutants
<a href="#">Appendix I</a>	148	Appendix I: Implications for Future Research

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[Frequently Asked Questions](#) | [Technical Information](#)

---

[EPA Home](#) | [Privacy and Security Notice](#) | [Contact Us](#)



# U.S. Environmental Protection Agency

Air & Radiation

[Recent Additions](#) | [Contact Us](#) | [Print Version](#) Search:

[EPA Home](#) > [Air & Radiation](#) > [Benefits and Costs of the Clean Air Act](#) > Study Design and Results

## Benefits and Costs of the Clean Air Act

[Where You Live](#)

[Indoor Air](#)

[Transportation/Fuels](#)

[Off-road Equipment](#)

[Acid Rain](#)

[Ozone Depletion](#)

[Climate Change](#)

[Visibility](#)

[Toxic Air Pollutants](#)

[Radiation](#)

## Study Design and Summary of Results

The report estimates the benefits and costs of historical air pollution control programs under the Clean Air Act by comparing the differences between two scenarios: a scenario which reflects historical economic and environmental conditions observed with the Clean Air Act in place and a hypothetical scenario which projects the economic and environmental conditions which would have prevailed without the federal, state, and local programs developed pursuant to the goals of the 1970 and 1977 Clean Air Acts.

Using a sophisticated array of computer models, EPA found that by 1990 the differences between the scenarios were so great that, under the so-called "no-control" case, an additional 205,000 Americans would have died prematurely and millions more would have suffered illnesses ranging from mild respiratory symptoms to heart disease, chronic bronchitis, asthma attacks, and other severe respiratory problems. In addition, the lack of Clean Air Act controls on the use of leaded gasoline would have resulted in major increases in child IQ loss and adult hypertension, heart disease, and stroke. Other benefits which could be quantified and expressed in dollar terms included visibility improvements, improvements in yields of some agricultural crops, improved worker attendance and productivity, and reduced household soiling damage.

When the human health, human welfare, and environmental effects which could be expressed in dollar terms were added up for the entire 20-year period, the total benefits of Clean Air Act programs were estimated to range from about \$6 trillion to about \$50 trillion, with a mean estimate of about \$22 trillion. These estimated benefits represent the estimated value Americans place on avoiding the dire air quality conditions and dramatic increases in illness and premature death which would have prevailed without the 1970 and 1977 Clean Air Act and its associated state and local programs. By comparison, the actual costs of achieving the pollution reductions observed over the 20 year period were \$523 billion, a small fraction of the estimated monetary benefits.

While the estimated net benefits may seem large, they reflect the huge differences between actual historical air quality achieved in the U.S. and a

model-predicted world without the Clean Air Act in which seven metropolitan areas in the U.S. would have had higher concentrations of particulate matter (a critical pollutant responsible for much of the adverse human health consequences) than Bangkok, Thailand. Six metropolitan areas would have been worse than Bombay, India; two would have been worse than Manila, Philippines; and one U.S. metropolitan area would even have been worse than Delhi, India (one of the most polluted cities in the world).

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[Frequently Asked Questions](#) | [Technical Information](#)

---

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# U.S. Environmental Protection Agency

Air & Radiation

[Recent Additions](#) | [Contact Us](#) | [Print Version](#) Search:

[EPA Home](#) > [Air & Radiation](#) > [Benefits and Costs of the Clean Air Act](#) > Study Review

## Benefits and Costs of the Clean Air Act

[Where You Live](#)

[Indoor Air](#)

[Transportation/Fuels](#)

[Off-road Equipment](#)

[Acid Rain](#)

[Ozone Depletion](#)

[Climate Change](#)

[Visibility](#)

[Toxic Air Pollutants](#)

[Radiation](#)

## Study Review

The retrospective study was designed and developed over a six year period, and received the most in-depth and extensive outside peer review ever completed for an EPA Report to Congress. This outside peer review, conducted on an ongoing basis throughout the full six-year period of study design and implementation, was provided by the [Science Advisory Board \(SAB\)](#) Council on Clean Air Act Compliance Analysis (Council), an independent panel of distinguished economists, scientists and public health experts chaired by Dr. Richard Schmalensee of the Massachusetts Institute of Technology (MIT), a former member of the Council of Economic Advisors under former President George Bush. In a July 8, 1997 letter to EPA concluding its review of the retrospective study, the SAB Council summarized its findings as follows: "The Council finds that the Retrospective Study Report to Congress by the Agency is a serious, careful study and employs sound methods along with the best data available. While we do not necessarily endorse all details of this study's findings, we believe that as a general matter that they are consistent with the weight of available evidence."

### List of SAB Council Members/Consultants

**Richard Schmalensee** of MIT

**Morton Lippmann** of New York University Medical Center

**William Nordhaus** of Yale University

**Paul Portney** of Resources for the Future

**Kip Viscusi** of Harvard University

**A. Myrick Freeman** of Bowdoin College

**Maureen Cropper** of the World Bank

**Ronald Cummings** of Georgia State University

**Daniel Dudek** of the Environmental Defense Fund

**Robert Mendelsohn** of Yale University

**Wayne Kachel** of MELE Associates

**William Cooper** of Michigan State University

**Thomas Tietenberg** of Colby College

**Paul Lioy** of the Robert Wood Johnson School of Medicine

**Roger McClellan** of the Chemical Industry Institute of Toxicology

**Richard Conway** of Union Carbide Corporation

**Wallace Oates** of the University of Maryland

**David V. Bates** of the University of British Columbia

**Gardner Brown, Jr.** of the University of Washington

**Timothy Larson** of the University of Washington

**Lester Lave** of Carnegie Mellon University

**Joseph Meyer** of the University of Wyoming

**Robert Rowe** of Hagler Bailly, Incorporated

**George Taylor** of the University of Nevada

**Bernard Weiss** of the University of Rochester Medical Center

**George Wolff** of the General Motors Research Laboratory

**Benjamin Liu** of the University of Minnesota

**Peter Mueller** of the Electric Power Research Institute

**Warren White** of Washington University

**Joe Mauderly** of the Lovelace Biomedical & Environmental Research Institute

**Philip Hopke** of Clarkson University

**Paulette Middleton** of Science Policy Associates

**James H. Price, Jr.** of the Texas Natural Resource Conservation Commission

**Harvey Jeffries** of the University of North Carolina, Chapel Hill.

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[Frequently Asked Questions](#) | [Technical Information](#)

---

[EPA Home](#) | [Privacy and Security Notice](#) | [Contact Us](#)



# U.S. Environmental Protection Agency

Air & Radiation

[Recent Additions](#) | [Contact Us](#) | [Print Version](#) Search:

[EPA Home](#) > [Air & Radiation](#) > [Benefits and Costs of the Clean Air Act](#) > Electronic Copy

## Benefits and Costs of the Clean Air Act

[Where You Live](#)

[Indoor Air](#)

[Transportation/Fuels](#)

[Off-road Equipment](#)

[Acid Rain](#)

[Ozone Depletion](#)

[Climate Change](#)

[Visibility](#)

[Toxic Air Pollutants](#)

[Radiation](#)

### Electronic Copy

The report includes a 1 page Abstract which briefly summarizes the study and its results, a 10 page Executive Summary which describes the study and its findings in more detail, seven main report chapters covering each of the major components of the analysis, ten technical appendices which provide in-depth documentation for each of the analytical components, and a file which contains the rest of the pieces of the full report (cover page, table of contents, list of acronyms and abbreviations, etc).

These report elements are available here in PDF format. After downloading the PDF file or files of interest, they can be read on screen or printed using the free Adobe(R) Acrobat(R) Reader. If you don't already have the Reader installed on your system you can [find out how to download it for free.](#)

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FILE	SIZE (KB)	DESCRIPTION
<a href="#">Abstract</a>	8	A brief abstract which summarizes the overall study and its findings (2 pages)
<a href="#">Contents, etc</a>	81	Up-front sections of the main report, including table of contents, acronyms and abbreviations, table of figures, table of tables, acknowledgments. (Does not include the Executive Summary.)
<a href="#">Executive Summary</a>	116	A more detailed summary, including graphical representations of the historical benefits and costs of Clean Air Act programs. (10 pages)

<a href="#">Main Report</a>	1,020	Seven chapter main report which provides basic information on the study design, individual analytical components methods and results (e.g., emissions modeling), aggregate benefit and cost results, and uncertainties. (58 pages)
<a href="#">Appendix A</a>	213	Describes in detail the estimation of direct compliance costs and the macroeconomic modeling of the effects of those expenditures.
<a href="#">Appendix B</a>	310	Provides details on the methodologies used to estimate control and no-control scenario emissions and the results obtained by these methods.
<a href="#">Appendix C</a>	1,785	Describes in detail the various methodologies used to translate differences in emissions under the control and no-controls scenarios into changes in air quality conditions; and includes summary characterizations of the results for target year 1990.
<a href="#">Appendix D</a>	1,359	Presents an overview of the approach used to model human health and welfare effects of criteria pollutants (as opposed to hazardous air pollutants), outlines the principles used to design and implement the physical effects analysis, presents the specific concentration-response functions used for each pollutant-endpoint combination (e.g., particulate matter-related premature mortality), and describes the physical incidence outcomes of the modeling.
<a href="#">Appendix E</a>	117	Discusses the potential ecological benefits of Clean Air Act program criteria pollutant controls in the context of three types of ecosystems: aquatic, wetland, and forest.
<a href="#">Appendix F</a>	75	Estimates the economic value of the differences in yields of some agricultural crops between the control and no-control scenarios.
<a href="#">Appendix G</a>	202	Describes in detail the analysis of the benefits resulting from the estimated reductions in lead in gasoline and from stationary sources achieved pursuant to the Clean Air Act.
<a href="#">Appendix H</a>	97	Presents quantitative estimates of the benefits of Clean Air act-related control of hazardous air pollutants (a.k.a. air toxics) for nonutility stationary source and mobile source categories. Noncancer effects and ecological effects are described qualitatively.
<a href="#">Appendix I</a>	941	Describes the basis for the methods and coefficients used to translate most of the quantified human health, welfare, and environmental effect incidences into measures of economic value, and presents the results of those calculations by individual endpoint.

<a href="#">Appendix J</a>	25	Provides examples of research topics which, if pursued, might improve the certainty and/or comprehensiveness of future section 812 benefit-cost studies of the Clean Air Act.
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[Frequently Asked Questions](#) | [Technical Information](#)

---

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