

Assessment of Air Quality Impacts on Health and the Environment - Program 92

Program Overview

Program Description

Protecting public health and the environment is the primary goal of environmental regulation. But achieving that goal is an ongoing dialogue among regulators, administrators, scientists, and others. The Clean Air Act's National Ambient Air Quality Standards (NAAQS) set limits for ambient concentrations of six "criteria" pollutants (carbon monoxide, lead, nitrogen dioxide, particulate matter [PM], ozone, and sulfur dioxide) considered harmful to public health and the environment. Recognizing that knowledge about health and environmental impacts of air pollutants evolves as scientific studies produce new results, the Clean Air Act requires periodic review of the standards and of the science upon which the standards are based. Conducting research that informs this review process is the focus of the Electric Power Research Institute's (EPRI's) Air Quality Health program.

This program delivers information on the health impacts of air pollution to help members, regulators, and other stakeholders develop scientifically sound policies and standards for achieving acceptable air quality to protect public health. The program's health effects information, developed from epidemiology, toxicology, and exposure assessment studies, addresses key scientific uncertainties related to health effects of PM, ozone, and other air pollutants. The focus of current research is on determining which components of air pollution are most closely associated with negative health impacts.

Research Value

EPRI's Air Quality Health program has the potential to affect a paradigm shift in how air pollution, specifically PM, is regulated in the United States and perhaps internationally. The current regulatory approach is mass-based and regulates the total PM concentration. However, PM is composed of thousands of individual components, and there is a growing consensus that not all of these components are equally toxic. EPRI's air quality health research addresses key scientific uncertainties to determine which components of air pollution are associated with negative health impacts and generates information to support health risk estimates of air pollution components. The value of the research is in its ability to identify the true causative agents, and the sources of those agents, affecting human health and the environment. With this program:

- air pollution health research considers the full spectrum of pollutants necessary to ensure that public health is adequately protected; further, EPRI is the only R&D organization that understands unique electricity sector issues and how they fit into the larger picture of emissions from other sources.
- peer-reviewed publications on the health effects of specific PM sources and components adds input into regulatory standard-setting processes.

Approach

EPRI air quality health research is critical to the U.S. Environmental Protection Agency's statute-required review of air pollution standards and will be considered in revision to NAAQS for PM expected in 2011 and 2016. EPRI also provides briefings to state and federal policymakers on its research results. EPRI takes a unique and multidisciplinary approach of combining epidemiology, toxicology, and exposure assessment studies organized into a new issue-based framework focusing on PM and components, criteria gases, ultrafine particles, emerging pollutants, and synthesis and integration. The issue areas will utilize the following study designs/disciplines to achieve the required results:

- Air pollution epidemiology studies examine human populations to determine the statistical links between pollutant exposures and adverse health effects.

- Exposure assessment studies characterize the type and sources of air pollution to which people are exposed.
- Toxicology studies are laboratory studies conducted in cell systems, animals, or humans that evaluate health impacts to pollutants under controlled conditions.
- Integrated epidemiology and toxicology studies evaluate consistency of results across these three types of studies to enable development of more-robust health effects information.

Accomplishments

EPRI's Air Quality Health program focuses on better understanding the roles played by PM components and other air pollutants. Accomplishments include the following:

- Epidemiology studies, such as the Aerosol Research and Inhalation Epidemiology Studies (ARIES), have significantly advanced knowledge of air pollution health effects, especially the differing potencies of PM components.
- Cohort studies, such as the Veterans Study, indicate the importance of traffic and organic compounds as predictors of premature mortality.
- The St. Louis Bus Study indicates the importance of short-term, peak exposures related to traffic.
- The Toxicological Evaluation of Realistic Emissions of Source Aerosols (TERESA) Study, examining the health effects of coal-fired power plant emissions, has shown only subtle effects in laboratory animals, which are generally milder than responses to concentrated ambient particles.

Current Year Activities

Program R&D for 2010 will focus on continuing to evaluate the relationships between air pollution and health, with emphasis on understanding the role played by specific PM sources and components. Specific efforts will include

- epidemiological studies to better determine the sources and components of air pollution responsible for health effects; ongoing studies will include ARIES, St. Louis ARIES, Texas ARIES, Pittsburgh ARIES, and the Children's Air Pollution Asthma Study;
- toxicological studies to provide additional information on the role played by different air pollutants in adverse health effects; studies will include the Tri City Concentrated Ambient Particle Study and the Michigan Integrated Cohort and Animal Particle Study;
- exposure assessment studies to evaluate the characteristics of exposures to air pollution; research will include evaluation of particle- and gas-phase exposures in microenvironments (e.g., homes) as well as personal exposures;
- integration of studies in epidemiology, toxicology, and exposure assessment through evaluation of EPRI and other research, to arrive at robust conclusions regarding health impacts of air pollution; and
- targeted communications to members and other stakeholders, including white papers, reviews, issue briefs, webcasts, and briefings.

Estimated 2010 Program Funding

\$2.2M

Program Manager

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Summary of Projects

Project Number	Project Title	Description
P92.001	Particulate Matter (PM) and Components	This project focuses on developing scientifically robust and sound information about the health effects of PM and its components using both epidemiological and toxicological approaches.
P92.002	Criteria Gases	This project will investigate the health effects of criteria gases (SO ₂ , NO ₂ , CO, and O ₃) using epidemiological and controlled human exposure approaches.
P92.003	Emerging Pollutants	Project will investigate the potential health impacts of emerging pollutants such as particle-phase organic compounds, VOCs, and UFs using both epidemiological and toxicological approaches.
P92.004	Integration and Synthesis	The project provides integrated information on air pollution and health that can be disseminated to stakeholders, including regulatory and other government agencies.
P92.005	Communications	This project provides access to a wide variety of communications tools related to air quality and health issues.

P92.001 Particulate Matter (PM) and Components (069215)

Key Research Question

The National Ambient Air Quality Standard (NAAQS) for PM is reviewed on an every-five-year cycle. This standard is often exceeded in many parts of the country, and secondary particles associated with utility emissions are a major component of ambient PM. One of the most pressing needs regarding the regulation of PM is a better understanding of the PM sources and components most strongly associated with adverse health impacts. High quality, scientifically robust, and focused epidemiological and toxicological studies are needed to inform regulators and other stakeholders about the differential toxicity of PM components in ensuing rounds of the NAAQS review. Health studies are the basis for ensuing regulatory responses by states, and it is critical that these agencies understand which sources may or may not be contributing to observed health effects while meeting mandated standards and developing state implementation plans (SIPs).

Approach

This project consists of specific studies aimed at increasing knowledge of health impacts of PM sources and components. Epidemiology studies, following the Aerosol Research and Inhalation Epidemiology Study (ARIES) model in Atlanta, will be carried out in several cities, including St. Louis, Dallas, Pittsburgh, and Birmingham. Studies will evaluate both mortality and morbidity endpoints (both cardiovascular and respiratory) when considering the effects of air pollution on human health. Advanced statistical techniques will be employed to determine the associations between specific PM components and various health endpoints and to integrate results across geographic areas. Other studies under the ARIES umbrella include the Detroit Cardiovascular Health Study and the Children's Air Pollution Asthma Study. Exposure assessment studies will be performed to increase knowledge of the primary sources of PM exposure in specific populations. Finally, toxicology studies will be carried out that focus on the contribution of individual PM sources and components to adverse health effects in laboratory animals. These studies include the Tri City Concentrated Ambient Particle Study and the Michigan Integrated Cohort and Animal Particle Study.

Impact

- Provides key information to be considered by EPA in the next review of the fine particulate matter (PM_{2.5}) NAAQS.
- Provides credible science to assist in the development of SIPs and other air quality regulations.
- Supports research designed to better protect public health.
- Provides cost-effective emissions reduction analyses. Identifying differences in PM component toxicity could have a significant impact on the costs to implement potential future emissions reductions.
- Provides a realistic estimate of the health impacts of coal generation.
- Aids members in their communication efforts with regulators and customers.

How to Apply Results

Members are encouraged to communicate project results widely. Members should be proactive in sending key stakeholders the results, making sure that stakeholders understand the results, and suggesting that results be considered as environmental policies (including standards, SIPs, and other regulatory decisions) are developed. EPRI staff will work with members to these ends. In addition to member efforts, EPRI will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI's public web page current; and continuing service on various advisory panels. Peer-reviewed scientific papers will be prepared by EPRI staff and contractors to ensure that the results meet the highest scientific standards. These papers will be made available to key stakeholders.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Epidemiological Studies of PM Components and Health: This peer literature deliverable will describe the associations between specific components of particulate matter and health endpoints, including pulmonary and cardiovascular.	12/31/10	Peer Literature
Toxicological Studies of PM Components and Health: This peer literature deliverable will describe the results of field toxicological studies to investigate the role played by PM components in adverse biological responses.	12/31/10	Peer Literature

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Epidemiological Studies of PM Components and Health: This peer literature deliverable will present results of epidemiological studies designed to investigate associations between PM components and health effects.	12/31/11	Peer Literature

P92.002 Criteria Gases (069216)

Key Research Question

Air pollution is a complex mixture composed of multiple particle- and gas-phase materials. The criteria gases, which are regulated by EPA under the NAAQS, include sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), and ozone (O₃). The roles played by these gases in health effects attributed to air pollution need to be clarified in order to most effectively protect public health, particularly in light of current NAAQS reviews for SO₂ and NO₂ which may lead to changes to these standards.

Approach

This project will examine, using a multidisciplinary approach of epidemiology and controlled human exposures, the health effects of criteria gases. In epidemiology studies like the suite of Aerosol Research and Inhalation Epidemiology Studies (ARIES), associations between criteria gases and mortality/morbidity endpoints will be examined individually (in single-pollutant models) as well as jointly with other pollutants (in multipollutant models). Controlled human exposures to SO₂ (and possibly NO₂) will be carried out to augment the available information on the health effects of short-term exposures to these gases. These exposure studies will focus primarily on asthmatics.

Impact

- Project research supports better protection of public health by determining which sources and components of air pollution are of most concern for human health.
- Project results will be considered by EPA in the review of the NAAQS.
- Research results will be used by state regulatory agencies in the development of state implementation plans.

How to Apply Results

Members are encouraged to communicate project results widely. Members should be proactive in sending key stakeholders the results, making sure that stakeholders understand the results, and suggesting that results be considered as environmental policies (including standards, state implementation plans, and other regulatory decisions) are developed. EPRI staff will work with members to these ends. In addition to member efforts, EPRI will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI's public web page current; and continuing service on various advisory panels.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Epidemiological Studies of Criteria Gases and Health Impacts: This deliverable will describe the epidemiological associations between criteria gases and adverse health impacts.	12/31/10	Peer Literature

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Controlled Human Exposures to SO₂: This deliverable will describe the results of human exposure studies (chamber studies) to SO ₂ .	12/31/11	Peer Literature

P92.003 Emerging Pollutants (069217)

Key Research Question

Regulation of ambient air pollution to date has focused on the six criteria pollutants: particulate matter (PM), lead, sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), and ozone (O₃). While these pollutants are clearly of importance to public health, other air pollution components may have health impacts also. In particular, there is accumulating evidence to suggest that organic compounds, both in the particle phase and in the form of volatile organic compounds (VOCs), may play a significant role in the adverse health effects observed in epidemiological and toxicological studies. Additionally, ultrafine particles (UFs; particles with a diameter less than 100 nm), also called nanoparticles, are coming under increasing scrutiny as their

possible health and environmental effects are investigated. It has been hypothesized that these very small sized particles may be more toxic than their larger counterparts because of increased surface area available to interact with biological tissues and because they can permeate physiological barriers more effectively; however, the evidence for an important role for UFs in adverse health effects is unclear. Although UFs constitute a negligible portion of the PM mass, there is a possibility of a number standard for PM if these particles are determined to be more toxic. There is a critical need to understand the health effects of these "emerging pollutants" in order to design and implement regulatory strategies to better protect public health.

Approach

Both epidemiological and toxicological studies will be carried out to investigate the health effects of emerging pollutants such as organic compounds. In epidemiological studies, these pollutants will either be measured or, in the case of retrospective data collection, estimated based on available data. Health endpoints will be associated with concentrations of these pollutants. One study under way is examining the responses of subjects with cardiovascular impairments in response to their exposures to ultrafine particles (as well as other pollutants), considering both community exposures and those in the rehabilitation facility where tests are performed. Toxicological studies will be carried out using either single-component exposures or simple mixtures with known concentrations of pollutants, or will employ a concentrated ambient particle (CAP) approach with measurement of targeted compounds and subsequent parsing of the biological response using statistical techniques. Results will increase understanding of the potential health risks of emerging pollutants.

Impact

- Comprehensive consideration of the complex air pollution mixture will ensure that the most harmful components are identified and can subsequently be controlled to best protect public health.
- As UFs become an increasingly important focus of research in the health and environmental fields, knowledge of the possible health impacts of ambient UFs is critical in order to develop appropriate mitigation strategies, if needed. This issue is of high importance because some air quality management strategies could result in increased exposures to UFs.
- Results will be considered by EPA during the NAAQS review.

How to Apply Results

Members are encouraged to communicate project results widely. Members should be proactive in sending key stakeholders the results, making sure that stakeholders understand the results, and suggesting that results be considered as environmental policies (including standards, state implementation plans, and other regulatory decisions) are developed. EPRI staff will work with members to these ends. In addition to member efforts, EPRI will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI's public web page current; and continuing service on various advisory panels. For this project it is particularly important for EPRI staff to work closely with those developing new mitigation strategies.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Epidemiological Studies of Ultrafine Particle Exposure and Health: This deliverable will describe results of an epidemiological panel study investigating the responses of subjects with cardiovascular impairments in response to their exposures to UFs, considering both community and microenvironmental exposures.	12/31/10	Peer Literature

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Epidemiological and/or Toxicological Studies of Emerging Pollutants and Health: This deliverable will document the results of epidemiological and/or toxicological research focused on emerging pollutants.	12/31/11	Peer Literature

P92.004 Integration and Synthesis (069218)

Key Research Question

Health concerns drive the regulatory agenda for air pollutants, including fine particulate matter (PM_{2.5}) and criteria gases. Determining the differing toxicities of air pollution components is dependent on sound epidemiological, toxicological, and exposure assessment studies. Ultimately, integration across these three disciplines represents a powerful approach for robust estimates of the health effects of specific air pollution components and/or sources.

Approach

This project will consider epidemiological, toxicological, and exposure assessment research on air pollution and health, conducted by both EPRI and others. The project will emphasize research related to the sources and components of air pollution associated with adverse health impacts. Consistency of findings across disciplines will be evaluated, and the state of scientific knowledge regarding the human health impacts of air pollution will be summarized. EPRI results will also be placed in the context of the broader scientific literature.

Impact

- Integrated and synthesized results can be considered by EPA in its reviews of the NAAQS for criteria gases and PM, which occur every five years.
- Research findings that are common across epidemiology, toxicology, and exposure assessment studies suggest more confidence in the overall results.

How to Apply Results

Members are encouraged to communicate project results widely. Members should be proactive in sending key stakeholders the results, making sure that stakeholders understand the results, and suggesting that results be considered as environmental policies (including standards, state implementation plans, and other regulatory decisions) are developed. EPRI staff will work with members to these ends. In addition to member efforts, EPRI will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI's public web page current; and continuing service on various advisory panels. Members should review the various communications supplied by EPRI (website summaries, issue briefs, presentation materials) for information that is relevant to their key air quality concerns.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Integration and Synthesis of Air Pollution Health Research: This technical update will summarize the results of multidisciplinary air pollution health research and present an integrative view of the status of the science.	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Integrated Analysis of Air Pollution Health Research: This peer literature deliverable will provide an integrated analysis of existing air pollution health research, including epidemiology, exposure assessment, and toxicology research.	12/31/11	Peer Literature

P92.005 Communications (069219)

Key Research Question

It is critical that research results in the air pollution health field be actively communicated to inform the public and other stakeholders. Informing key stakeholders of the latest scientific findings on health issues is extremely valuable, given EPRI's objective and credible research results and its standing in the scientific community.

Approach

This project will provide succinct descriptions of key research findings and implications on a timely basis. The goal is to provide tools and information to aid members in communicating research findings to lay audiences, such as the popular media and policymakers. Communications efforts aimed at preparing two-page issue briefs will continue; current briefs will be continually updated and new issue briefs will be prepared as needed. Webcasts will be presented on relevant topics. Presentations to key stakeholders and detailed communications tools will be prepared on an as-needed basis. Special workshops will be convened as appropriate to aid member communication efforts on key air quality issues.

Impact

- Results of significant research are effectively communicated to members, the public, the media, regulatory/policy communities, and other stakeholders, thus improving decision making and supporting science-based policy.
- The review of external studies (reports and papers) helps members stay up to date on the latest research findings from other groups.
- This project facilitates informed interaction with decision makers by providing timely and succinct communications materials.

How to Apply Results

Members should review the various communications supplied by EPRI (website summaries, issue briefs, presentation materials) for information that is relevant to their key air quality concerns.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Communication Tools: This deliverable consists of a wide variety of communication tools (e.g., webcasts, issue briefs, workshops) to aid members in communicating to stakeholders on air quality health issues.	12/31/10	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Communication Tools: This deliverable consists of a wide variety of communication tools (e.g., webcasts, issue briefs, workshops) to aid members in communicating to stakeholders on air quality health issues.	12/31/11	Technical Resource