

91 Assessment Tools for Ozone, Particulate Matter, Regional Haze and Atmospheric Deposition

Program Overview

Program Description

This program helps members, policymakers, regulators, and other stakeholders develop scientifically sound air quality management policies and plans. The program provides information and tools that enable cost-effective environmental compliance by allocating emission reductions in a fair and equitable manner among sources and optimizing attainment of air quality standards. Products include models that clarify how emissions from different sources contribute to the formation of ozone, particulate matter, regional haze, and atmospheric deposition. Additional products include research on atmospheric chemistry and ambient measurement methods essential to allow health scientists to identify which components of air pollution are most harmful in the environment. The program provides effective communication materials to facilitate informed discussion among the Electric Power Research Institute (EPRI), its members, and key stakeholders.

Industry Needs and Issues Addressed

- Implementation of various Clean Air Act regulatory programs, including the National Ambient Air Quality Standards, State Implementation Plans (SIPs), regional haze rules, and Prevention of Significant Deterioration permitting, requires the highest quality science for informed rulemaking.
- Rigorous air quality models based on credible atmospheric science and its application in regulatory case studies are needed to inform state and federal air quality management actions in response to more-stringent ozone and particulate matter (PM) standards.
- Research is essential for a more rigorous and realistic assessment of contributions to regional haze from various emission sources and transboundary pollution.
- Improved techniques are needed for estimating emissions from sources whose emissions are highly uncertain to allow for an improved decisionmaking process.
- Atmospheric measurements are needed to identify which components of air pollution are associated with adverse health impacts and to inform the development and application of air quality modeling tools and source-receptor analysis techniques.
- Enhanced understanding is needed of how atmospheric chemical reactions, especially those involving power-plant emissions, influence the formation, composition, and health effects of PM.
- Multimedia research is needed on the interactions between air quality and climate change and the linkages between air and watershed management.
- The industry needs independent, credible technical experts who can effectively work with regulatory agencies and the environmental science community.
- Communications materials are needed to inform policymakers, regulators, and other key stakeholders.

Impact

- Provides effective communication material that facilitates informed discussion between members and key decision-makers
- Develops advanced air quality models that can be applied to develop SIPs in partnership with state and federal agencies
- Informs environmental compliance activities, asset management, and long-term strategic planning by members
- Provides comprehensive information on PM sources, chemistry, and composition essential to understanding health effects of air quality

- Improves emissions inventories of sources whose emissions are highly uncertain to allow for improved decisionmaking processes by policymakers, regulators, and other key stakeholders
- Helps companies address emerging air quality and multimedia issues
- Establishes integral relationships with industry, government agencies, academia, and consulting firms

Key Accomplishments

- Advanced the science supporting air quality models used for policy development, regulatory decisionmaking, and implementation planning
- Implemented an advanced plume-in-grid module in order to better characterize the specific impact of power plant emissions on ozone, PM, and atmospheric deposition
- Developed and received regulatory acceptance of a new algorithm for more-realistic accounting of contributions to regional haze
- Highlighted the importance of transboundary pollution in regional haze considerations
- Clarified the role of acids in the formation of secondary organic aerosol (SOA), and improved representation of SOA formation processes in air quality models
- Provided timely communication materials that facilitate the ability of members to respond to questions raised by policymakers, regulators, and other stakeholders

Current Year Objectives

- Enhance air quality models and apply those models in regulatory case studies to understand the contribution of power plants to ozone, PM, haze, and atmospheric deposition
- Conduct additional testing to enhance understanding of contributions to regional haze from various emission sources and other factors
- Continue to provide comprehensive information on PM sources, chemistry, and composition essential to understanding health effects of air quality
- Improve emissions inventories of highly uncertain categories
- Continue to develop improved modules for representing organic PM in air quality models
- Develop linkages between air-quality and watershed models that can be used to accurately assess the contribution of atmospheric deposition from different sources to sensitive ecosystems and waterways
- Continue to provide timely communication materials

Industry Involvement

- Estimated 2009 funding: \$4.0M

Program Technical Lead

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Summary of Projects

Project Number	Project Title	Value
P91.001	Air Quality Model Development and Application	This project develops and evaluates computational air quality models, thereby enhancing their capability and reliability in air quality management. Advancing the science within these models and evaluating them thoroughly increases the confidence in their use for developing environmental policies and regulations. In addition, this project applies the models to examine regulatory case studies to help regulators understand which sources contribute to ozone, particulate matter, regional haze, and

Project Number	Project Title	Value
		atmospheric deposition.
P91.002	Regional Haze Studies	This project advances visibility research by performing state-of-the-art experimental studies at various national parks to provide data to develop a better understanding of the contribution of different sources to regional haze. Focused experimental studies will explore how field and laboratory protocols used to measure, collect, and analyze PM may bias estimates of the contribution of different components of PM to regional haze. The project will also continue to explore the extent of influence of transboundary pollution and natural processes on regional haze.
P91.003	Emissions, Measurements and Source-Receptor Analysis	Determining sources that contribute to ambient pollution levels and quantifying those contributions are crucial in devising control strategies to meet regulatory requirements. This project enhances knowledge of emissions sources and their impact on air quality through a three-pronged approach aimed at improving emissions inventories, ambient measurements, and source-receptor analysis.
P91.004	Communications	The project objective is to communicate key air quality research findings and their implications on a timely basis. Communications activities under this program inform decisionmaking and support the development of scientifically sound environmental policy through effective dissemination of significant research results to EPRI members, policymakers, regulators, scientists, and the public at large. These results are communicated via succinct descriptions of key EPRI research findings; presentations, briefings, and testimony to key stakeholders; detailed summary papers on EPRI research and analysis on major issues; and critical reviews of external studies.

Project Descriptions

91.001 Air Quality Model Development and Application (P21294)

Issue

In response to increasingly stringent environmental regulations, there is a continuing need to enhance air quality models in their representation of the atmospheric chemistry and transport of ozone, particulate matter, regional haze, and atmospheric deposition. These enhancements aim to improve model performance in real-world applications, such as the development of air quality policies or implementation plans (i.e., control strategies) for compliance with air quality regulations.

Current air quality models lack an appropriate representation of organic particulate matter, which can be as prevalent as sulfate particles in urban areas and can contribute significantly to regional particle levels. Pertinent to health-oriented studies, these models also do not simulate ultrafine particles well. Enhanced models developed in this project will provide the best available tools to stakeholders for developing plans in order to attain ozone and particulate matter standards and meet regional haze goals. For example, these models can be used to assess different control technology and control strategy options.

Description

This project develops and evaluates computational air quality models. It enhances model capability and reliability for air quality management applications. Advancing the science and thoroughly evaluating the models increases confidence in their use for environmental policies and regulations development. In addition, this project applies the models to regulatory case studies and helps regulators understand which

sources contribute to ozone, particulate, regional haze, and atmospheric deposition. Major project activities include

- development of enhanced modules for accurately simulating the different components of particulate matter, especially organic particles, in air quality models;
- enhancement of EPRI's advanced plume-in-grid module in order to better characterize the impact of power plant emissions on ozone, particulate matter, and atmospheric deposition;
- improvements to modules simulating cloud chemistry and processing of gases and particulate matter;
- development and evaluation of superior air quality modeling systems for simulating the chemistry, transport, and deposition of atmospheric gases and particles in the environment; and
- model applications to examine the latest regulatory issues pertaining to ozone, particulate matter, regional haze, and atmospheric deposition

Value

- EPRI's advanced plume-in-grid modules will help electric companies—as well as decisionmakers and other stakeholders—better characterize the impact of power plant emissions on ozone and particulate matter formation and atmospheric deposition.
- Advancing the science within these models and evaluating them thoroughly increases confidence in their use for developing future environmental policies and regulations.
- Applications of the models in regulatory case studies will help regulators understand which sources contribute to ozone, particulate, regional haze, and atmospheric deposition.
- Case studies using these models could result in more cost-effective rules as regulators can replace overly simplistic assumptions in existing tools with air quality models based on credible, sound science.

How to Apply Results

EPRI members can apply and use enhancements in air quality models in several ways:

- Air quality models can be used by members or their consultants for applications pertinent to the operation of their facilities.
- Air quality models can be used by federal and state agencies when developing environmental policies and regulations.
- Air quality models can be used by regulatory agencies in development of state implementation plans to meet air quality goals.
- Modules developed by EPRI in other modeling systems can be adopted into air quality models.

EPRI will facilitate regulatory approval of models and their enhancement by working in collaboration with federal regulatory agencies and submitting the model enhancements for formal review and adoption. Members can increase the probability of use of EPRI models by working cooperatively with state regulators and encouraging the use of those models. EPRI will also work with members in developing cooperative projects that enhance application and use of these models. In addition, EPRI will facilitate broader use and awareness of the EPRI modeling results by providing timely communication materials, including content available through EPRI's public internet site, and through continuing service on various advisory panels.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
<p>Development of Air Quality Models for Ozone, Particulate Matter, and Deposition The research in this project will continue to focus on improving air quality models in order to accurately represent ozone, components of particulate matter, and atmospheric deposition. In particular, the work will focus on the EPRI Advanced Modeling System for Transport, Emissions, Reaction, and Deposition of Atmospheric Material (AMSTERDAM) framework, and on development and improvement of scientifically sound modules for physical and chemical processes, such as the Advanced Plume Treatment (APT) plume-in-grid module and the Model of Aerosol Dynamics, Reaction, Ionization, and Dissolution (MADRID) module for particulate matter. New and improved modules will be implemented into the AMSTERDAM framework and evaluated against observed data.</p>	12/31/2009	Peer Literature

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<p>Case Study: Contributions of Emission Sources to Ozone and Particulate Matter Concentrations: The EPRI AMSTERDAM framework will be applied to examine how different control strategies might be able to meet new air quality standards for ozone and PM promulgated by the U.S. Environmental Protection Agency (EPA). Both local and regional controls will be considered in developing control strategies. Evaluating both regional and local controls will aid understanding of how different emissions contribute to nonattainment designations and which controls are most effective in order to meet new air quality standards. The results will be published in a technical report and communicated to key stakeholders, including regulators and policymakers in federal and state agencies.</p>	2010	Peer Literature

P91.002 Regional Haze Studies (103321)

Issue

EPA’s Regional Haze Rule (RHR) is a long-term regulation that requires visibility in Class I areas to return to natural levels by 2064. In attributing haze to emissions from a specific source, an important step is calculating the relationship between fine particle composition and haze by estimating how much light is scattered or absorbed by sulfate, nitrate, organic materials, black carbon, and other particulate matter components.

EPRI’s research developed a new algorithm for calculating haze indices and attributing haze levels to specific components. This algorithm has been accepted by EPA. Many outstanding issues still remain in understanding the relationship between particle composition and haze, and further research is needed. These issues will be addressed by collection of new particle and visibility data at Class I areas and by focused laboratory studies.

Another key parameter in the RHR is the definition of natural visibility conditions for each Class I area that must be achieved by 2064. EPA’s definition of this endpoint does not include transboundary anthropogenic pollutants, as well as new science pertinent to understanding naturally occurring levels of particles contributing to haze. Although EPRI research has demonstrated that states need to recognize the importance of transboundary pollution when developing plans for meeting regional haze progress

goals, significant uncertainty remains in estimating the transboundary contribution of organic aerosol concentrations.

Description

EPRI research has played a crucial role in developing a new approach to implementing the RHR and its adoption by EPA. However, many outstanding issues still remain in understanding regional haze impacts from different sources, and further research is needed. These issues will be addressed by collection of new particle and visibility data at Class I areas and by focused laboratory studies. EPRI research on these issues will provide a more rigorous and realistic assessment of the contributions of various emission sources to visibility degradation in Class I areas.

Specific tasks include

- conducting new advanced experimental studies at various national parks during different seasons to provide data that will be used to further develop better understanding of the contribution of different sources to regional haze;
- complement the above studies with focused experimental studies to understand how field and laboratory protocols used to measure, collect, and analyze particulate matter may bias estimates of regional haze; and
- further explore the extent of influence of transboundary pollution on regional haze in the United States by focusing on organic aerosol.

Value

- Improves decisionmaking by developing advanced methods for attributing haze to specific sources
- Provides a more rigorous and realistic assessment of contributions from various emission sources to visibility degradation in Class I areas
- Informs state agencies about haze in general—and the contribution of power plants to haze in particular—as the agencies prepare State Implementation Plans (SIPs) aimed at defining the most cost-effective measures to address local and regional air quality concerns

How to Apply Results

Members are encouraged to widely communicate project results. Members should be proactive in sending results to key stakeholders, making sure that stakeholders understand the results, and suggesting that these results be considered in development of environmental policies, including standards, SIPs, and other regulatory decisions. EPRI staff is willing to 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Visibility Studies at Class I Areas: Clarifying the Contributions to Regional Haze: Continuing research in this project will focus on better understanding of natural and background visibility and those aspects of particulate matter affecting visibility impairment that are currently not well understood (e.g., water uptake by organic aerosols). This research will also benefit from the research on the development of better modules for organic particulate matter under the previous project (P91.002).	12/31/2009	Peer Literature

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Evaluation of Field and Laboratory Protocols Applied for Regional Haze Rule Regulation: This deliverable will complement the above studies with focused experimental studies to understand how field and laboratory protocols used to measure, collect, and analyze particulate matter may bias estimates of regional haze.	2010	Peer Literature

P91.003 Emissions, Measurements and Source-Receptor Analysis (052314)
Issue

Accurate emission inventories are essential to designing sound control strategies to mitigate air pollution. Emissions from many source categories—particularly those associated with on-road and nonroad mobile sources—are estimated using computer models based on limited, incomplete, and often obsolete data. These issues can result in incorrect assignment of the relative contributions of various sources to pollutant emissions, and can thereby dramatically affect subsequent policymaking and regulatory processes.

Improving the detail and resolution of atmospheric measurements is essential for studying the health effects of air pollution, as well as for developing better assessment tools and techniques used in weight-of-evidence analysis to determine sources contributing to pollution at a receptor site. Measurements provide the necessary input to source-receptor models, described below, and are used to evaluate three-dimensional air quality models described earlier (P91.002). Highly resolved measurements are essential to inform the development of air quality modeling tools and source-receptor analysis techniques.

Receptor models interpret measurements of physical and chemical properties pertinent to air quality taken over time at a particular location (the *receptor*) to quantify the contributions from different sources. Receptor models have been shown in the past to effectively estimate source contributions for primary pollutants and particulate matter. However, in their current state, these models are inappropriate for determining the contribution of sources to levels of secondary pollutants, such as sulfates and nitrates. Nonetheless, the models are widely used ostensibly to identify sources contributing to secondary particulate matter and are applied in weight-of-evidence attainment demonstrations.

Description

Current methods for estimating emissions from sources other than power plants can result in incorrect assignment of the relative contributions of various sources to pollutant emissions. Whereas power plants use continuous emissions monitors (CEMs), emissions from other sources are based on outdated or incomplete models. These inaccuracies can impact air quality assessments—such as those performed using three-dimensional air quality models that use emissions inventories as fundamental input—and thereby dramatically affect subsequent policymaking and regulatory processes. This project will enhance knowledge and improve the tools and techniques for estimating emissions from sources with the most uncertain emissions to improve decisionmaking processes.

This project will also improve the detail and resolution of atmospheric measurements. Improving these measurements (especially for organic gases and particles) will enable an understanding of which components of air pollution are most harmful in the environment. Highly resolved measurements are essential to inform the development of air quality modeling tools and source-receptor analysis techniques.

In advancing the science of receptor models, EPRI research will evaluate and apply various receptor models and data analysis techniques to apportion atmospheric pollutants to different sources in specific

U.S. locations. EPRI will review different receptor models to document strengths and weaknesses of each model and provide guidance on proper use and appropriate interpretation of the results.

Value

- Improves decisionmaking by expanding knowledge of non-power-plant sources contributing to ozone and particulate matter levels
- Improves the detail and resolution of atmospheric measurements, enabling health researchers to determine how the various components of air pollution contribute to observed health effects in the environment and informing the development and application of air quality modeling tools and source-receptor analysis techniques
- Provides guidance on the proper use of receptor models and appropriate interpretation of results
- Determines accurately the extent to which different sources are contributing to air pollution, enabling electric energy companies, regulators, policymakers, and other stakeholders to determine the most efficient, cost-effective measures to address local and regional air quality concerns

How to Apply Results

Members are encouraged to widely communicate project results. Members should be proactive in sending results to key stakeholders, making sure that stakeholders understand the results, and suggesting that these results be considered in development of environmental policies, including standards, State Implementation Plans, and other regulatory decisions. EPRI staff is willing to 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
<p>Evaluation and Application of Receptor Models to Determine Source Attribution: This deliverable will focus on evaluation and application of receptor models for specific locations in the United States. A series of scientific manuscripts published in the peer-reviewed literature will underscore the limitations of receptor models and provide guidance for the proper application of the models and appropriate interpretation of results.</p>	12/31/2009	Peer Literature

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<p>Evaluation and Improvement of Emissions Inventories: This project will enhance knowledge and improve tools and techniques for estimating emissions from the most uncertain categories to allow for an improved decisionmaking process.</p>	2010	Peer Literature

P91.004 Communications (060356)**Issue**

EPRI research on various air quality issues will have enhanced value to members and society if the results are actively communicated to and applied by key stakeholders, particularly federal and state government policymakers and regulators. EPRI's reputation for credible research results and its standing in the scientific community provide opportunities for informing key stakeholders of the latest scientific findings on air quality issues. EPRI members have recognized the critical nature of the communication materials provided to date and continue to underscore the importance of continuously updating these materials as new information becomes available.

Description

Effective communication of EPRI research on air quality issues is essential for the results to be considered and applied by the policymaking and regulatory communities. Communications activities under this program inform decisionmaking and support the development of scientifically sound environmental policy through effective dissemination of significant research results to EPRI members, policymakers, regulators, scientists, and the public at large.

These results are communicated via

- succinct descriptions of key EPRI research findings and their implications on a timely basis;
- presentations, briefings, and testimony to key stakeholders;
- detailed summary papers on EPRI research and analysis on major issues; and
- critical reviews of external studies published in technical reports or technical papers.

Value

- Informs decisionmaking and supports the development of scientifically sound environmental policy through effective dissemination of significant research results to EPRI members, policymakers, regulators, scientists, and the public at large
- Helps EPRI members stay current on the latest research findings from other groups through reviews of external studies (technical reports and scientific papers)
- Facilitates informed interaction between EPRI members and decisionmakers through succinct communications materials, targeted presentations, and detailed reports on a timely basis
- Ensures that costly air quality regulations are based on sound science and that investments in technology to reduce emissions provide maximum societal value

How to Apply Results

Members should review the communications materials for information that is relevant to their stakeholders, policymakers, and regulators. This information is useful to member company corporate communications departments and local, state, and federal liaisons in creating messages and plans to proactively communicate the research findings to appropriate stakeholder groups. In addition, EPRI facilitates the application of the results through briefings and testimony to key stakeholders, including state and federal government agencies, as pivotal studies appear or as state or federal actions dictate.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Air Quality Communication Materials: Relevant communications materials will be prepared and provided to members to help them understand and communicate the current state of knowledge on ozone, particulate matter, regional haze, and atmospheric deposition. Communication materials will be prepared in a way to facilitate the ability of members to respond to questions that may be raised by policymakers, regulators, or other stakeholders or internally in their companies.	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Air Quality Communication Materials: Relevant communications materials will be prepared and provided to members to help them understand and communicate the current state of knowledge on ozone, particulate matter, regional haze, and atmospheric deposition. Communication materials will be prepared in a way to facilitate the ability of members to respond to questions that may be raised by policymakers, regulators, or other stakeholders or internally in their companies.	2010	Technical Resource
