Environmental Monitoring, Evaluation, and Protection (EMEP)

A Case Study Prepared by Oak Ridge National Laboratory and the New York State Energy Research and Development Authority

Introduction

The primary mission of the Environmental Monitoring, Evaluation, and Protection Program (EMEP) is to support research that addresses environmental issues related to the generation of electricity. New York's electric utilities, individually and through associations, historically provided a stable funding stream for environmental research. However, with the restructuring of the electric industry, the utilities are no longer in the generating business and thus, are not obligated to sponsor environmental research. The **New York Energy $mart**[SM] Program employs System Benefits Charge (SBC) funds to ensure that critical energy-related environmental research programs continue through EMEP.

Since its inception in 1998, the EMEP has provided objective and policy-relevant research to:

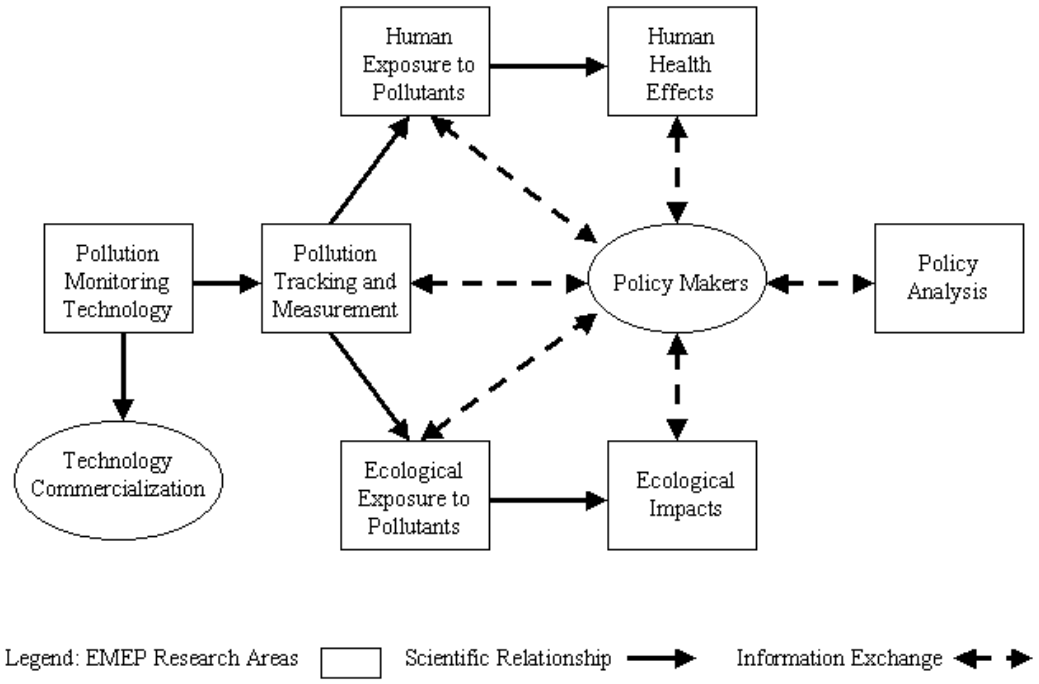
- Improve the scientific understanding of electricity-related pollutants in the environment;
- Assess the environmental impact of electricity generation relative to other sources of pollution;
- Help develop approaches to mitigate impact of electricity generation and improve environmental quality; and,
- Provide information to policy makers who develop environmental regulation and law.

Comparable programs have been instituted in other states with public benefits funding, including California and Wisconsin. The Wisconsin *Focus on Energy* program used EMEP as a template for designing its program.

Program Strategy

An 11-member Program Advisory Group comprised of representatives from the New York State Departments of Environmental Conservation (NYSDEC), Health (NYSDOH), and Public Service; the U.S. Environmental Protection Agency (USEPA), the National Oceanic and Atmospheric Administration (NOAA), a utility organization, and other public interest organizations guides the EMEP program. A Science Advisory Board, composed of university-based, federal, and non-profit researchers, assists EMEP in the development of its multi-year research plan

Figure 1. Schematic of NYSERDA's Environmental Monitoring, Evaluation, and Protection (EMEP) Program



and provides periodic review of critically important research products. All research proposals submitted to EMEP are rigorously peer reviewed and the principal investigators are required to present project updates to both program and science advisors. The scientific quality of EMEP-funded projects is very high; over 100 articles based on EMEP-funded research have appeared in refereed journals.

When the SBC program was extended in 2001, NYSERDA, with the assistance of over 30 external advisors operating in two working groups, developed a multi-year research plan for the EMEP Program. The plan calls for research in the areas of air quality and pollutant deposition related to both ecological and human health as shown in Figure 1. Attention is focused on atmospheric deposition of Sulfur (S), Nitrogen (N), and Mercury (Hg) as well as particulate matter (PM) and ozone. Particular emphasis is placed on environmental accountability by establishing environmental baselines and evaluating changes in the environment as new emission control programs are launched. Several external EMEP advisors and other people knowledgeable about EMEP interviewed for this case study commented that EMEP's portfolio of research projects is well-balanced, produces outstanding science, and synthesizes well with national environmental research initiatives (such as those funded by the EPA) and national environmental research needs.

Policy Focus

What sets the EMEP apart from other such programs is its dedication to introducing the latest scientific findings into the policy arena through: frequent meetings and conferences with analysts, policy makers and scientists; translation of scientific studies into forms useful for a broad audience; and provision of environmental data and scientific findings in a timely manner. John Holsapple, Executive Director of the Environmental Energy Alliance of New York, commented that the EMEP has been particularly successful at bringing researchers and key policy makers into one room "lots of times."

Table 1, featured at the end of this document, summarizes some of the communication activities between the science and policy communities that have been supported by EMEP. For example, 225 professionals attended the EMEP Fall 2003 Conference held in Albany, New York. Presentations ranged from poster sessions containing information about pollution's effect on the loon population to presentations about Particulate Matter (PM) emissions.

As illustrated in Figure 1, scientists working on projects represented by each box interact with the policy-makers to report project findings. The research has had direct impact on public policy related to the environment. For example, data from the Adirondack Lakes Survey Corporation's Long Term Monitoring project has been instrumental in the development of Governor George Pataki's Acid Rain Initiative and other national level proposals. Furthermore, EMEP research provides the underlying data that are being used in the development of the State's Fine Particulate Matter (PM 2.5) State Implementation Plan (SIP). EMEP funded pollution research led the U.S. Environmental Protection Agency (EPA) to change its guideline for complying with ozone air quality standards.

A Brief Summary of Research Supported by the EMEP

EMEP research began in 1998 and is funded at $2.7 million per year through 2006. Total funding for the program under the eight-year SBC program is $21.5 million. Through December 2003, a total of 34 projects have been initiated, and 10 have been completed. A total of $17 million has been allocated to these projects and EMEP funds have attracted over $20 million in project co-funding. One interviewee was particularly impressed with the EMEP's ability not only to leverage external funding, but also its ability to provide 'seed funding' to New York universities that allows them to become more competitive for national research grants. For example, it was pointed out that EMEP seed funding, in part, has lead to New York being the only state with two EPA-funded particulate matter research centers, located at the University of Rochester and New York University.

In December 2003, EMEP approved funding for 15 new research projects costing approximately $8.5 million and with expected co-funding of $5 million. These new projects are summarized in Table 2 at the end of this case study. Three of the new projects are directly concerned with new technologies and policy analysis. Six new projects address acid rain, mercury and nitrogen and generally support environmental accountability of control programs by evaluating effects in New York. The remaining six new projects address fine particles and provide the scientific foundation for formulation of State Implementation Plans to attain ambient air quality standards.

Highlighted Projects

To better understand the depth of the EMEP's accomplishments, three projects were chosen for closer review. The first project is known as the New York "Supersite" Project and is focused on comprehensively tracking and monitoring air pollutants affecting New York. The second project supported the development and commercialization of new air pollutant monitoring technologies. The third project is part of the ecological health track and focuses on the effects of mercury contamination in the Adirondacks.

Supersite Project:
Project Duration 1998 – Present

Combustion of fuels is a significant source of ambient fine particles in New York. The New York State "Supersite" air quality tracking and monitoring system is a national research model.

Supersite Project Funding Information
NYSERDA Funding = $ 3.5 million
Co-funding = $ 6.6 million

The Supersite project objectives are to:

- measure the temporal and spatial distributions of particulate matter measuring 2.5 microns or smaller in size (PM2.5) and its many co-pollutants (*e.g.*, sulfur dioxide, ozone, nitrogen oxide);
- monitor the effectiveness of new emissions control technologies introduced in New York City; and
- test and evaluate new measurement technologies.

What makes the Supersite system unique is the breadth and depth of air pollutant data that are collected throughout the State. It is measuring the suite of ozone and PM precursors that will ultimately enable policy makers to assess the effectiveness of a variety of pollution control strategies, when sustained over the long term.

The EMEP provided the initial funding for this effort in 1998, and has also garnered significant financial support from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). The Atmospheric Sciences Research Center (ASRC) at the State University of New York at Albany is leading this project as one of NYSERDA's research partners. Other collaborators include the New York State Departments of Health, and Transportation; Clarkson University; Areodyne Research; and Brookhaven National Laboratory.

The New York Supersite system comprises five monitoring sites: three urban sites located in New York City, and two regional sites in Upstate New York (Figure 2). A total of 45 separate data collection devices are used to collect data on a daily basis. The Supersite system provides air pollutant tracking and monitoring information to researchers studying human and ecosystem exposure to pollutants. The Supersite system also provides information directly to policy makers about local, state, and regional sources of air pollutants.

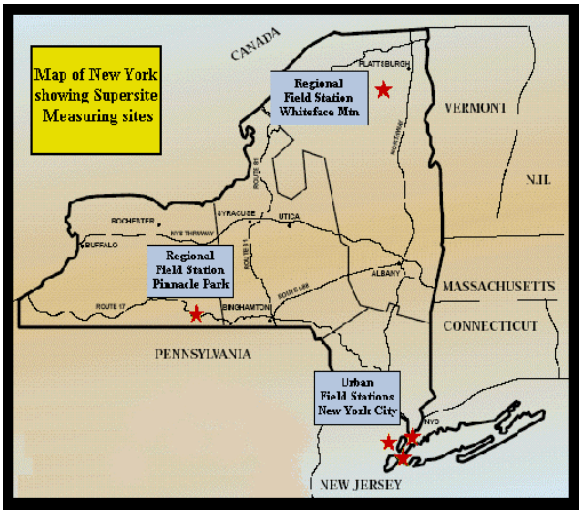


Figure 2. Map showing Supersite Monitoring Field Stations

According to the New York State Department of Environmental Conservation, the impact of this research has been highly significant, and it will provide a sound scientific basis for effective decisions regarding management of air quality in New York. The information gained from this project will also provide economic and environmental benefits to the citizens of New York.

Nine peer-reviewed publications have been associated with the Supersites in New York City. These articles range from emission studies of New York City vehicles to a comparative analysis of the various PM measurement methods.

Particulate Matter Monitoring Technology Projects:
Project Duration 1999 - 2003

One objective of the EMEP is testing and evaluation of new pollutant monitoring technologies. The instrumentation development efforts supported by the EMEP not only provides more accurate environmental data, but also provides opportunities for economic development in New York.

The need for new monitoring technologies has been acute with respect to measuring PM. In response to this need, the EMEP provided funding to Rupprecht & Patashnick Co., Inc., a New York-based company, to develop two new PM monitoring technologies.

PM Monitoring Project Information

NYSERDA Funding = $500,000

Co-funding = $950,000

In the past, to comply with National Ambient Air Quality Standards that require annual and 24-hour standards for PM2.5 measurement, filters were weighed, set out to collect a sample for 24 hours, retrieved, and then reweighed. This allowed some idea of the average 24-hour PM2.5 mass concentration. Unfortunately, condensation or evaporation of semivolatile materials on the filters made extremely accurate measurements difficult to obtain. Furthermore, this method is labor-intensive.

To solve this problem, Rupprecht & Patashnick Co., Inc. developed two products based on the use of a Tapered Element Oscillating Microbalance (TEOM©), which is a patented inertial mass measurement technique for making a direct measurement of the particle mass collected on a filter in real time. This allows for continuous and accurate monitoring of fine particulate matter in ambient air.

Additionally, two major advances in real-time monitoring of the particles were developed through support from the EMEP. One innovation reduces the moisture content of the sampled ambient air so that the

temperature of the monitoring device can be reduced from 50°C to 30°C. The other improvement accounts for the loss of semivolatile materials on the filter surface. The devices have the potential to provide extremely accurate and timely data that can be used to improve health effects studies, verify the impact of state implementation for controlling PM2.5, and reduce ambient air monitoring costs.

Figure 3. Filter Dynamic Measuring System (FDMS) by Rupprecht & Patashnick Co., Inc

Jeffery Ambs, Senior Mechanical Engineer for Rupprecht & Patashnick Co., Inc. has worked on these EMEP-supported projects. He stated that without NYSERDA funds, research for these new technologies would have taken significantly longer to complete. According to Harvey Patashnick, sales of these technologies approached $1 million in their introductory year. Additionally, the company's patent for one of these technologies was recently nominated for a regional inventor-of-the-year award.

Long-Term Monitoring and Assessment of Mercury in the Common Loon: Project Duration 2002 - Present

One of the goals of the EMEP is to provide an environmental baseline and means of evaluating the effectiveness of emission control programs. A variety of proposals to control mercury emissions from utilities have recently been advanced. This project seeks to provide a baseline for mercury levels in the common loon and evaluate the risk mercury deposition poses to the environment in the Adirondack Park.

The Adirondack Cooperative Loon Program, a partnership of the Wildlife Conservation Society, Natural History Museum of the Adirondacks, NYSDEC, BioDiversity Research Institute, and the Audubon Society of New York State, is using the common loon (Figure 4) as an indicator species to better understand the impact of environmental mercury contamination on aquatic ecosystems in New York's Adirondack Park. Dr. Nina Schoch, Program Coordinator of the Adirondack Cooperative Loon Program, believes that loons are an excellent indicator of mercury contamination in the Adirondack lakes because the loons are at the top of the food chain and bioconcentrate toxins in their aquatic habitats; they consume fish that have eaten plankton contaminated with mercury, which accumulates in predators higher on the food chain. Humans may also be exposed to increased mercury levels when they consume contaminated fish.

The mercury levels in loon blood, feathers, and eggs, as well as other organisms, water, and sediments determined in this research project will be used to develop a mercury exposure profile and a mercury hazard profile for common loons. These profiles will then be employed in developing a Wildlife Criterion Value, a quantitative assessment of the ecological damage and risk mercury deposition poses to Adirondack aquatic ecosystems. This project expands upon research conducted from 1998-2000 in the Park that measured loon mercury levels in relation to their reproductive success, which indicated that 17% of the loons sampled had mercury levels high enough to

impact their reproductive success. Mercury affects the neurological system of loons, resulting in behavioral changes, including increases lethargy and decreased ability to incubate their eggs and raise young successfully to fledging age.

Long-Term Monitoring & Assessment of Mercury in the Common Loon Project Funding Information

NYSERDA Funding = $255,955
NYSDEC Funding = $60,609
Natural History Museum of the Adirondacks Funding = $82,671
Wildlife Conservation Society Funding = $105,760
Biodiversity Research Institute Funding = $20,000
Audubon Society of New York State Funding = $10,000

Figure 4. A photograph of the Common Loon (*Gavia immer*)

In Summer 2003, data were collected on 28 loons from 18 Adirondack lakes. Twenty-two of these birds were banded with United States Fish and Wildlife Service uniquely colored plastic bands to aid in field identification to subsequently determine loon survival and productivity. Results from this project, linking loon mercury levels with reproductive success, will be provided to the U.S. EPA to develop a population model to evaluate the impact of environmental mercury contamination on the Adirondack loon population.

The prey fish mercury results will be given to NYSDEC and NYSDOH to aid in identifying Adirondack lakes to be further evaluated for issuing fish consumption advisories. Furthermore, the increased knowledge gained through this research of the intricate relationships between biotic and abiotic mercury levels throughout the food chain will provide a stronger foundation for regulatory agencies to make regulatory decisions about environmental mercury contamination based on abiotic components alone. Thanks to the financial support of the EMEP, nearly 50 lakes inhabited by loons will continue to be examined over the next two years. Without this assistance, much of this research and associated outreach efforts would not be conducted.

Conclusion

The ultimate purpose of the EMEP is to provide verifiable scientific information in order to make policy decisions to improve human health and protect the environment. The EMEP has been making progress towards this goal within the limits necessarily imposed by time and budget constraints. With electric industry restructuring, new data and information concerning emissions associated with electricity generation and other energy sources are continually needed. These data and information will keep policy makers well informed of changes resulting from the transformed economic and regulatory climate. The individuals interviewed for this case study were unanimous in their praise for the EMEP and urged the EMEP to "keep on going."

TABLE 1. Highlights of Recent EMEP Science and Policy Communication Activities

Product	Activity	Target Audience
Conferences, Workshops, Seminars in 2003		
Conference	Organized a two-day conference with plenary presentations, breakout sessions, panel discussions, and poster presentations to share information on energy-related environmental research in New York State and its implications for policy making.	Scientists, policy makers/analysts, public interest groups, and industry
Workshop	Convened a meeting to discuss progress and future research plans in the PM Supersite Program.	Researchers and agencies involved in the PM Supersite Program
Workshop	Sponsored a workshop to develop and discuss statistical methods for identifying the emission sources contributing to ambient PM.	Scientists, policy makers/analysts
Training	Sponsored training for regulatory agencies in the use of state-of-the-art modeling methods for identifying sources contributing to ambient PM	Agencies responsible for State Implementation Planning
Advisors Meeting	Convened EMEP Advisors to discuss and identify priority areas for future EMEP solicitations.	EMEP Program Advisory Group and Science Advisors
Program Review Meeting	Convened a two-day meeting to review technical progress on air quality research projects and discuss implications.	EMEP Principle Investigators, EMEP Program Advisory Group and Science Advisors
Project Review Meetings	Held and/or participated in over a dozen project review meetings to develop and refine research plans and share preliminary research results.	Project participants, relevant State agencies
Publications in 2003*		
Conference Proceedings	Organized, edited, managed peer review, and published special issue report in the *J. of Environmental Pollution* on scientific papers presented at the EMEP 2001 conference.	Research scientists, policy analysts
Peer-Reviewed Publications	Sponsored research that lead to the publication of 17 peer-reviewed journal articles in 2003.	Research scientists, policy analysts
Special Communications	Published two "Special Communications" which integrated findings across multiple EMEP research projects and produced short summary papers on the implications of the research.	Policy makers, policy analysts
EMEP Final Project Reports	Peer reviewed and published four EMEP final reports.	Policy makers/analysts, public interest groups, industry, and scientists
EMEP Newsletter	Published first issue of the EMEP Newsletter to raise awareness of the research findings supported by the program.	Policy makers/analysts, public interest groups, industry, and scientists
Works-In-Progress 2004		
Primers	Developing short papers on the scientific basis of a variety of energy-related environmental issues, including mercury, acid rain, and ozone and fine particles.	Policy makers/analysts, State agencies, general public
EMEP Web page	Restructuring the EMEP web page to increase the information content and technical search capability, and to include information relevant to a broad general audience including students and teachers.	Broad spectrum of stakeholders, w/ targeted communication strategies and sections for different audiences
EMEP Conference Summary Papers	Drafting and editing a series of summary papers on key topics discussed at the 2003 EMEP Conference.	Policy makers/analysts, public interest groups, industry, and scientists
EMEP Newsletter	Publishing the Summer 2004 issue of the EMEP Newsletter.	Policy makers/analysts, public interest groups, industry, and scientists
EMEP Final Project Reports	Peer reviewing drafts of seven EMEP project reports.	Policy makers/analysts, public interest groups, industry, and scientists

*Currently posted on the EMEP web page.

TABLE 2. Highlights of EMEP Research Projects Selected for Funding in 2003

Title	Research Scope	Policy Relevance	NYSERDA's Research Partner
Technological Assessment and Policy Analysis			
Emission Reduction Credits/Allowances for CHP	Documents the potential and process for creating Emission Reduction Credits (ERCs) and/or emission allowances for combined heat and power (CHP) units.	Supports New York's goal of fostering DG/CHP. May also increase supply of ERCs in the State which are needed to site new power generation.	Navigant Consulting
Environmental Impacts of CHP	Quantifies the environmental impacts of increased deployment of CHP in New York.	Provides analysis that can be used to help formulate emission control strategies for CHP.	Navigant Consulting
Multi-Pollutant Policies for the Electricity Sector	Provides a comprehensive analysis of the impact of potential multi-pollutant utility policies on New York State.	Provides objective information which can help New York State assess options and formulate a position on emerging multipollutant policy initiatives.	Resources for the Future
Ecosystem Response to Nitrogen, Sulfur, and Mercury Depositions			
Acid Deposition in Landscapes	Develops an approach to extrapolate impacts observed in an intensive study-site to a broader geographic area.	Supports environmental accountability of acid rain control programs, by evaluating effects in New York.	E&S Environmental Chemistry Inc.
Recovery of Acidification in the Catskills	Assesses the degree of recovery of water chemistry and stream biota from reduced levels of acid deposition at a sensitive watershed in the Catskills.	Supports environmental accountability of acid rain control programs, by evaluating effects in New York.	U.S. Geological Survey
Episodic and Chronic Acidification in the Adirondacks	Characterizes current conditions with respect to episodic and chronic acidification in sensitive watersheds in the Adirondacks.	Supports environmental accountability of acid rain control programs, by evaluating effects in New York.	U.S. Geological Survey
Mercury Levels in Fish	Provides strategic monitoring of mercury in fish in New York State and compares to an existing database of historical levels.	Supports environmental accountability of future mercury control programs, by establishing baselines and evaluating effects in New York.	New York State Dept. of Environmental Conservation
Mercury Deposition Monitoring	Determines the mercury concentration in wet deposition at two sites in New York, as part of the National Mercury Deposition Network.	Supports environmental accountability of future mercury control programs, by establishing baselines in New York.	U.S. Geological Survey, Syracuse University
Source Apportionment of Nitrogen Pollution using Stable Isotopes	Explores the viability of using isotopic techniques to determine contribution of reactive nitrogen from combustion sources vs natural sources. Attempts to apportion nitrogen pollution to specific types of combustion (e.g., motor vehicle, utility).	May provide scientific foundation for more effective nitrogen pollution control strategies affecting utilities and other sources.	U.S. Geological Survey, SUNY College of Environmental Science and Forestry
Mercury Monitoring in Common Loons and Adirondack Lakes	Provides baseline for mercury contamination in common loons and Adirondack lake food webs.	Provides baseline to evaluate effectiveness of mercury emission control strategies.	Adirondack Cooperative Loon Program/ Wildlife Conservation Society

Air Quality and Related Health Research: Particulates and Co-Pollutants			
Fine Particle Technology Assessment and Characterization ("PM Supersite")	Characterizes fine particles (PM2.5) and precursors at urban sites and rural sites in New York State; evaluates monitoring technology; and evaluates pollution control strategies.	Provides the scientific foundation to formulate effective PM2.5 air quality management plans, which will affect utilities and other energy systems.	State University at Albany
Measurement of Fine Particles in Western and Northern New York	Characterizes PM2.5 at two sites in New York State and attempts to determine the contribution of in-state and out-of state sources to ambient PM2.5. Using advanced statistical methods, estimates how much ambient PM2.5 is coming from utilities, motor vehicles, and other sources.	Provides the scientific foundation to formulate effective PM2.5 air quality management plans, which will affect utilities and other energy systems.	Clarkson University
Fine Particles and Health Effects	Supports data analysis and conducts a workshop on fine particle source apportionment and health effects.	Provides a tool used for the development of SIPs to comply with ambient fine particle air quality standards.	Clarkson University/ New York University
Organic Component of Fine Particles	Analyzes the organic component of fine particles collected in New York City and attempts to identify the combustion sources of the organic fraction of fine particles.	Provides the scientific foundation to formulate effective PM2.5 air quality management plans, which will affect utilities and other energy systems.	Rutgers University
Formation Mechanisms of Fine Particles	Explores mechanisms for ultrafine particles formation in motor vehicle exhaust and studies the transformation of particles as they are dispersed and mixed with ambient air.	Provides the scientific foundation to formulate effective PM2.5 air quality management plans, which will affect utilities and other energy systems.	State University at Albany
Fine Particle Emission Profiles	Measures fine particles emissions from distributed generation sources and biofuel combustion systems.	Helps develop the fine particle emission inventory, which will be used in formulating effective PM2.5 air quality management plans	GE Energy & Environmental Research Corp.

Sources Reviewed:

Dr. Praveen Aman, Director, Science and Policy, Northeast States for Coordinated Air Use Management (NESCAUM)

Jeffery Ambs, Senior Mechanical Engineer for Rupprecht & Patashnick Co., Inc.

John Bachman, Associate Director for Science Policy and New Programs, U.S. Environmental Protection Agency

Kenneth L. Demerjian, Principal Investigator, "Science Policy Highlights" Memorandum to NYSERDA and NYSDEC.

EMEP News, Summer 2003

Stuart Finley, Institute for Ecosystems Studies

John Holsapple, Executive Director, Environmental Energy Alliance of New York

PM2.5 Technology Assessment and Characterization Study – New York www.asrc.cestm.albany.edu/pmtacsny/index.html

Dave Shaw, Director, Division of Air, New York State Department of Environmental Conservation

Rupprecht & Patashnick Co., Inc. www.rpco.com/