NYSERDA's
Environmental Monitoring, Evaluation and Protection (EMEP) Program

Overview of Accomplishments prepared for the September 19, 2006 EMEP Program Review

New York Energy Smart℠

EMEP

Environmental Monitoring, Evaluation, & Protection

NYSERDA's
Environmental Monitoring, Evaluation, and Protection (EMEP) Program

Overview of Accomplishments

Prepared for the 9/19/06 EMEP Program Review

TABLE OF CONTENTS

Section Page

1: BACKGROUND……..……..……....1

2: EMEP PROGRAM RESOURCES……..…….....3

3: KNOWLEDGE CREATION FROM THE EMEP PROGRAM ……..……7
Program Planning…….....7
Research Project Development and Selection Activities……...8
Funding and Management of Collaborative Research Projects……8
Knowledge Synthesis: Highlights of Findings from EMEP Research…….…....21

4: KNOWLEDGE DISSEMINATION AND INFORMATION EXCHANGE…….....28
Overview of Communications Activities……....28
Relevance, Acceptance and Use by the Scientific Community……..33
Relevance, Acceptance and Use by Policy/Decision Makers and Impacts on New Policies, Regulations, and Resource Management Decisions….....35

5: OTHER POTENTIAL ELEMENTS OF PROGRAM IMPACT EVALUATION…..40
Commercialization Progress……...40
Energy, Economic, and Environmental Benefits……40

FIGURES

Figure 1: Current EMEP Portfolio

Figure 2: Highlights from EMEP-Supported Projects Related to Air Quality and Health Effects

Figure 3: Highlights from EMEP-Supported Projects Related to the Deposition of Sulfur, Nitrogen, and Mercury

Figure 4: Highlights from Completed EMEP-Supported Projects Crosscutting the Issues of Air Quality, Health, Ecological Response, and Energy

Figure 5: Citations of EMEP Research Papers

TABLES

Table 1: Summary of Resources Committed Through the EMEP Program

Table 2: New York Energy $mart[sm] Environmental Monitoring, Evaluation, and Protection Program Project Portfolio

Table 3: EMEP Projects Initiated to Address Research Needs Identified in the EMEP Research Plan

Table 4: Program/Science Advisory Meetings

Table 5: EMEP Web Site Hits by Month and Year

Table 6: Top 20 Downloads from March 2005 through June 2006

Table 7: EMEP Science & Policy Communication Activities: 1998-2006

Table 8: Papers with the Highest Impact Ratio (Expected No. of Citations Versus Actual No. of Citations)

Table 9: Highlights of EMEP-Related Briefings to Policymakers

APPENDICES

Appendix A: EMEP Program Logic Diagram and Evaluation Framework

Appendix B: EMEP Program Plan

Appendix C: Team Memos

Appendix D: Project Fact Sheets

Appendix E: Knowledge Synthesis Papers

Appendix F: EMEP Program Communication Strategy

Appendix G: Peer-Reviewed Publications, by Research Area

Appendix H: Previous Evaluation of EMEP Instrument Development Projects

Section 1: Background

The primary mission of the **New York Energy $mart**[SM] Environmental Monitoring, Evaluation, and Protection (EMEP) Program is to support research to address 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 electric industry restructuring, the utilities are no longer in the generating business and thus, aren't 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. EMEP provides scientifically credible, objective and policy-relevant research aimed at two primary goals:

- Enhancing understanding of the nature and characteristics of energy-related pollution and its impact on the environment and human health; and
- Characterizing sources of energy-related pollution and defining cost-effective policies to mitigate impacts and opportunities for emissions reduction.

The program focuses on electricity-related environmental issues in New York State. EMEP is currently supporting a diverse research portfolio in three areas:

- Ecosystem response to deposition of sulfur, nitrogen, and mercury;
- Air quality and related health research associated with particulate matter, ozone, and co-pollutants; and
- Crosscutting environmental science, technology, and policy projects.

Particular emphasis is placed on "environmental accountability" by establishing environmental baselines and evaluating changes in the environment as new emission control programs are launched. In addition, EMEP initiatives include elements focused on introducing its 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

EMEP has also supported a variety of research projects at various New York institutions and development and demonstration of better instruments for monitoring ambient air and water affected by pollution.

A Program Advisory Group comprising representatives from New York State and federal agencies, utility organizations, and other public interest organizations guides the EMEP

program.[1] A Science Advisory Committee, composed of university-based, federal, and non-profit researchers, assists EMEP in the development of its multi-year research plan and provides periodic review of critically important research.[2] The EMEP program reaches out extensively to these groups to provide external oversight throughout the development and progression of all research projects. 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 – leading to very high scientific quality of EMEP-funded projects.

Key EMEP policy objectives include:

- Development and evaluation of the effectiveness of pollution control strategies for acid deposition, mercury, ozone and co-pollutants, and particulate matter including providing the scientific basis for a PM2.5 State Implementation Plan (SIP);
- Quantification of local sources versus regional transport of fine particles, ozone, ozone precursors, mercury, and acid deposition precursors to develop more equitable pollution control strategies;
- Assessment of the relationships between fine particles, ozone, and co-pollutants with health effects to support development of control strategies to effectively mitigate health impacts;
- Identification of alternative environmental protection and mitigation strategies to reduce the impacts of acidification and exposure to mercury in New York; and
- Development of emerging multi-media/multi-pollutant environmental protection strategies.

The scientific scope of potential research topics for EMEP is broad and includes:

- Biogeochemical cycling and ecosystems impacts of sulfur, nitrogen and mercury species;

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[1] **Current PAG members:** Alan Belensz, NYS Office of the Attorney General; Andrew Darrell, Environmental Defense; Richard Haeuber, Clean Air Markets Division, USEPA; Daniel Luttinger, NYSDOH; Sandra Meier, Environmental Energy Alliance of New York; Tina Palmero, NYSDPS; ST Rao, Atmospheric Sciences Modeling Division, USEPA & National Oceanic and Atmospheric Administration; Christina Dowd, Habitat Protection, NYSDEC; Gopal Sistla, Air Research, NYS Dept. of Environmental Conservation (NYSDEC); James Vickery, National Exposure Research Laboratory, USEPA; Ross Whaley, Adirondack Park Agency; Ronald Wyzga, Electric Power Research Institute. **Past PAG members**: James deWaal Malefyt/K. Bala/Peter Seidman, NYS Dept. of Public Service (NYSDPS); Ellen Baum, Clean Air Task Force; Rona Birnbaum, Clean Air Markets Division, USEPA; James Colquhoun/Steve Sanford, Bureau of Habitat, NYSDEC; Stacey Davis, Center for Clean Air Policy; Michael DiNunzio/Bernard Melewski/Radmilla Miletich, Adirondack Council; Lloyd Wilson/Edward Horn, NYS Dept. of Health (NYSDOH); Rashid Shaikh, New York Academy of Sciences; Edward Smeloff, Pace University School of Law; David Wooley, Pace University Energy Project; John Holsapple, Environmental Energy Alliance of New York.

[2] **Current Science Advisors:** Daniel Jacob, Harvard University; Praveen Amar, Northeast States for Coordinated Air Use Management (NESCAUM); Patrick Kinney, Columbia University School of Public Health; Stuart Findlay, Institute of Ecosystem Studies; William Fitzgerald, University of Connecticut; John Irwin**,** Retired, USEPA; George Hidy, Envair/Aerochem; Richard Schlesinger, Pace University. **Past Science Advisors**: Greg Lawrence, US Geological Survey; Scott Ollinger, University of New Hampshire.

- Factors limiting or promoting recovery of acidification;
- Relative environmental impacts of atmospheric deposition compared to other sources;
- Economic damage assessments and economic impacts of potential strategies;
- Characterization of atmospheric aerosols, co-pollutants and aerosol precursors;
- Fate and transport of primary and secondary particulate matter, ozone, ozone precursors and co-pollutants with respect to sources and receptors; and
- Relationship of atmospheric concentrations, compositions, and size to human health and other environmental concerns.

These research needs for New York State far exceed the funding available under EMEP. Therefore, program success requires coordination, collaboration, and leveraging with other state and federal agencies and co-funding of research projects. Synthesis and communication of research results is a key goal of the EMEP program (*i.e.*, the true test of success is the utilization of findings by policy makers to improve both environmental quality and human health). To achieve this goal, research findings are synthesized and translated into understandable formats, forums are provided for scientists and policy makers to discuss issues, and funding organizations are constantly seeking opportunities for collaboration. The EMEP program includes an aggressive communication and outreach policy to support this goal of science-policy integration to ensure that results from NYSERDA's EMEP research efforts are used.

For the purpose of this Peer Review, EMEP program activities have been grouped, where appropriate, into four distinct areas:

- Program Planning – including reviewing background research and convening research planning meetings with scientists, policymakers, analysts and other relevant stakeholders.
- Developing and Selecting Research Projects – including refining research focus areas for solicitation, developing and marketing solicitations, and reviewing and selecting proposal.
- Contracting with and Managing Collaborative Research Projects – including developing research contracts with scopes, budgets (including co-funding), and schedules; launching projects; evaluating progress; sharing interim findings; reviewing draft reports; and producing final NYSERDA project reports.
- Information Exchange – including preparing and disseminating summary reports and synthesis papers, sponsoring workshops and conferences, making data and information publicly available through the web, providing briefings, publishing NYSERDA reports and technical journal articles.

<u>Results To-Date/Outlook for the Future:</u> Through these activities, NYSERDA's EMEP program has developed a Research Plan that reflects a common understanding of energy-related environmental research needs which, if addressed will support informed decision-making in New York State, the region and nationally. In addition, the EMEP program

has effectively identified and implemented a portfolio of research projects specifically designed to meet high priority research needs within this Plan. A number of individual projects have been completed (or are in various stages of completion) and are: successfully achieving key research objectives; resulting in high quality and in-demand reports, briefing materials, technical journal articles etc.; advancing scientific and policy-relevant knowledge; enhancing the exchange of important environmental research information among scientists and policy-makers; strengthening New York State's research infrastructure; and contributing to the formulation of effective and equitable energy-related environmental policies and resource management practices.

Looking forward, the program has been renewed for another five years, with funding of $3.5 million per year from 2006 through 2011. The main research focus areas launched under EMEP will continue and some new focus areas will be added, including global climate change and assessing and mitigating the environmental impacts from alternative energy resources.

The input provided from this review effort will help NYSERDA in developing future EMEP programs.

For more information on the EMEP program, see
www.nyserda.org/programs/environment/EMEP

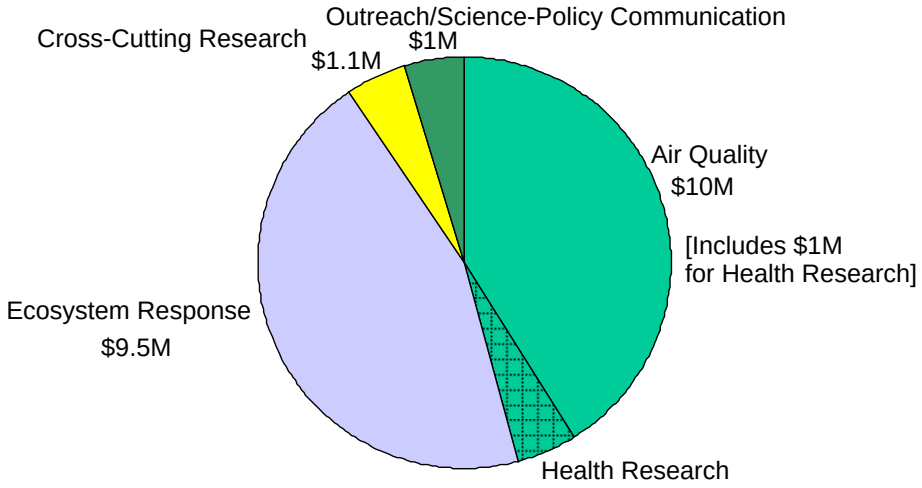
Section 2: EMEP Program Resources

Table 1 in this section lists the funding levels, funding partners, and contractors associated with solicitations issued through the EMEP program from 1998 through 2006. NYSERDA staff and other resources made available to this program are also described.

The pie chart in Figure 1 illustrates the allocation of resources by program area.

Figure 1. Current EMEP Portfolio

$21.6 million NYSERDA/$44 million total



46 research projects (16 completed, 30 active)

Table 1: Summary of Resources Committed Through the EMEP Program

Contract ID	Projects Identified in the Public Service Commission SBC1 Order*	Program Opportunity Notice (PON) 444	PON 446	PON 497	PON 540	PON 586	PON 682	PON 839	Unsolicited/ Sole-Source Projects
Number of Contractors	6	2	3	1	6	8	12	8	8
Start Date	1998	Feb-99	Jun-99	Oct-99	Oct-00	Jul-01	Jan-03	Jul-04	N/A
NYSERDA Funding	$3,165,917	$456,557	$1,159,875	$450,000	$850,780	$4,195,434	$5,298,703	$2,563,719	$3,557,326
	PON 594 consisted of two outreach contracts totaling $611,243 in NYSERDA funds.								
Estimate of NYSERDA staff resources used for project	NYSERDA has dedicated approximately 2.5 full-time equivalent (FTE) staff since 1998 supporting these research efforts. Specific responsibilities for support of this program include defining research needs; developing and managing research solicitations; evaluating proposals; contracting projects; reviewing work statements for funding; reviewing project reporting and invoicing; reviewing project final reports; production and dissemination of outreach materials, including Web materials and newsletters, as appropriate; and participating in technical/policy and project-related meetings.								

*These were ongoing projects identified in the 1998 Public Service Commission System Benefits Charge (SBC) Order as critical to policy formulation in New York State. They were transferred from ESEERCO to NYSERDA after technical review.

Section 3: Knowledge Creation from the EMEP Program

This section identifies intermediate performance indicators and knowledge creation associated with the EMEP program. An illustration of the NYSERDA performance goals/targets, broader public benefits/outcomes, and performance indicators associated with the various elements of the EMEP program is presented in Appendix A and provides the evaluation framework for the material in the following sections.

3.1 Program Planning

In 2001 NYSERDA initiated a comprehensive planning effort to provide direction for environmental research in New York State over the next five years, with a focus on pollution associated with the generation of electricity. Potential users of the plan include NYSERDA, other New York State/regional/national research funding organizations, the scientific community, public benefit organizations, and policy makers. The goal and philosophy of this effort was to identify critical research that:

- is policy-relevant;
- is inter-disciplinary/multi-media;
- will be useable for New York State—not just for NYSERDA's EMEP program; and
- takes advantage of related national research plans and programs to address regional/state needs.

Within the plan, prioritized key research areas were identified that were suitable to be addressed through the EMEP program, as well as in collaboration with other funding organizations

NYSERDA convened working groups of science and policy experts to help develop the plan. Policy objectives were identified to guide the research scoping process so that the research would be most useful and applicable to environmental management challenges facing New York State. Potential priority research areas were identified and presented at the EMEP conference in Albany, NY, to over 200 participants for additional input. The draft plan was distributed to the EMEP Program Advisory Group for final review. All of the EMEP PONs issued since 2002 have been guided by the Research Plan. In addition, the EMEP plan has been cited by others in developing/identifying research needs (e.g., *Acid Rain and the Adirondacks: A Research Summary*, prepared in 2005 by the Adirondack Lakes Survey Corporation). Over 1200 copies of the EMEP Research Plan have been downloaded from NYSERDA's website.

This plan is a work in progress. As research findings become available and policies are implemented, it will be necessary to continually revisit and revise this plan to ensure that it effectively addresses the current and future environmental issues of concern. The plan is scheduled to be updated in late 2006. The plan in its current form can be found in Appendix B.

3.2 Research Project Development and Selection Activities

EMEP solicitations were issued to target research needs identified in the EMEP research plan. Program Opportunity Notices (PONs) were advertised broadly and sent directly to potential researchers. NYSERDA's process to evaluate and select research projects includes numerous internal controls and input from program, legal, contract, communications and evaluation staff. Technical evaluation panels include more external (non-NYSERDA) reviewers than NYSERDA staff. Recommendations from the panel were reviewed and approved by senior management prior to awarding contracts.

The attached "Team Memos" [Appendix C] describe the process followed for each of the 7 EMEP solicitation issued to date. Appendix C identifies the targeted research areas in each solicitation.

3.3 Funding and Management of Collaborative Research Projects

Table 2 displays the portfolio of EMEP research projects, including both completed and ongoing projects. For more information on these projects, see Appendix D. Appendix D contains a 2-page summary for each project including preliminary project findings and implications.

To date, EMEP has funded 46 research projects, 16 of which have been completed. The distribution of the research projects in the focus areas is as follows:

- Air quality and related health research associated with particulate matter, ozone, and co-pollutants (18 projects, $9.9 M NYSERDA, $22 M total project cost);

- Ecosystem response to deposition of sulfur, nitrogen, and mercury (21 projects, $9.6 M NYSERDA, $20 M total project cost);

- Crosscutting environmental science, energy, technology, and policy projects (7 projects, $1.1 M NYSERDA, $1.6 M total project cost).

Table 3 summarizes the research target areas identified in the Research Plan and identifies the EMEP projects that were funded to address these needs. As can be seen in Table 3, the majority of high-priority research needs identified in the EMEP planning process are now being addressed by specific EMEP research projects.

Section 3.4 (Knowledge Synthesis) summarizes the knowledge gained from these research projects and highlights how these projects have advanced the state-of-science in key policy relevant areas.

Table 2: New York Energy $mart[sm] Environmental Monitoring, Evaluation, and Protection Program Project Portfolio					
Contract #	Title	Principal Investigator and Research Organizations	Site	Total Project Cost	NYSERDA Cost
Air Quality and Related Health Research associated with Fine Particles, Ozone and Co-Pollutants					
4913	*Clinical Studies of Exposure to Ultrafine Particles	Dr. Mark Utell, Univ. of Rochester Medical Center	Rochester (clinical)	$817,141	$480,851
4914	*Analysis of Ozone and Fine Particles in the Northeast	Dr. S.T. Rao, SUNY-Albany	Statewide (modeling)	$547,749	$547,749
4918	Enhanced Measurements of Oxidants, Fine Particles and their Precursors	Dr. Kenneth Demerjian, SUNY-Albany	Whiteface Mtn, Pinnacle St. Park, NYC/Queens	$9,584,586	$3,879,617
5060	*Development and Demonstration of Continuous Ambient Particulate Monitor (R&P 6400 series)	Dr. Harvey Patashnick, Rupprecht & Patashnick Co., Inc.	Albany (lab work), field site	$122,078	$49,880
6083	Impact of In-and Out-of-State Power Plants on Semivolatile Pollutants in New York	Dr. Philip Hopke, Clarkson University	Stockton, Brockport (NYS northwest border)	$1,538,980	$1,143,118
6084	Source Apportionment of Fine Particles in New York City	Dr. George Thurston, NYU Medical Center	New York City, Tuxedo	$801,432	$489,358
6085	*Assessing the Effects of Transboundary Pollution on New York's Air Quality	Dr. S.T. Rao, NYS Dept. of Environmental Conservation	Canadian-NYS border, statewide (modeling)	$661,169	$387,919
6183	*Development and Demonstration of Innovative Instrument for Ambient Particulate Matter Mass Measurement Standard	Dr. Harvey Patashnick, Rupprecht & Patashnick Co., Inc.	Albany (lab work), field site	$1,328,580	$450,000
6230**	*Fine/Ultrafine Particulate Emissions Profiles	Dr. Paul Drayton, Gas Technology Institute; Dr. Glen England, GE-EER	New York State, California, others	$2,113,599	$198,000
6484	Fine Particle Constituents and Acute Asthma in Urban Areas	Dr. Daniel Luttinger, Health Research Inc./NYSDOH	New York City	$239,238	$184,965
6820	*Monitoring Particle Size Distribution in Rochester	Dr. Philip Hopke, Clarkson University	Rochester, NY	$246,555	$165,783
7607	*Workshop on Incorporation of Receptor Models into PM and Adverse Health Effects Study	Dr. Phil Hopke, Clarkson University	Statewide	$41,461	$30,112
7616	Chemical Composition of Fine Organic Particles from Urban Regional Background Locations in New York State	Dr. Monica Mazurek, Rutgers University	New York City, Pinnacle State Park, NYSDEC Testing Lab	$1,101,849	$678,890
7618	Formation and Transformation of Particles in Motor Engine Exhaust	Dr. Fangqun Yu, University at Albany	Statewide	$176,576	$100,000

Table 2: New York Energy $mart[sm] Environmental Monitoring, Evaluation, and Protection Program Project Portfolio					
Contract #	Title	Principal Investigator and Research Organizations	Site	Total Project Cost	NYSERDA Cost
7919	Analysis of PM Data in NY Using Advanced Source Apportionment Methods	Dr. Philip Hopke, Clarkson University	Statewide	$716,830	$200,000
8641	Assessment of Carbonaceous Fine Particle (PM2.5) for New York and the Region	Dr. Phil Johnson, NESCAUM	Statewide and Region	$491,477	$352,974
8643	Physical and Chemical Characterization of Laboratory-Generated Secondary Semi-volatile Organic Particles	Dr. Kenneth Demerjian, SUNY Albany	Albany, NY	$504,777	$299,998
8650	Ultrafine Particles and Cardiac Responses: Evaluation in a Cardiac Rehabilitation Center	Dr. Mark Utell, Univ. of Rochester Medical Center	Rochester, NY	$946,255	$300,000
Total number of Fine Particle and Ozone research projects: 18				**$21,980,332**	**$9,939,214**
Ecosystem Response to Deposition of Sulfur, Nitrogen and Mercury					
4915	Long-Term Monitoring Program for Evaluating Changes in Water Quality in Adirondack Lakes	Karen Roy. Adirondack Lakes Survey Corporation (ALSC)	52 Lakes in Adirondacks	$10,067,076	$3,845,443
4916	Mercury in Adirondack/Catskills Wetlands, Lakes and Terrestrial Systems	Dr. Ronald Munson, Tetra Tech, Dr. Charles Driscoll, Syracuse University	Sunday Lake (Adirondacks) & various sites in the Catskills	$1,193,597	$727,684
4917	Evaluation of the Recovery from Acidification of Surface Waters in the Adirondacks	Dr. Myron Mitchell, SUNY College of Env. Science and Forestry - Syracuse	Arbutus Pond, Hunt. Wildlife Forest, Statewide modeling	$1,200,896	$962,517
6086	*Effects of Atmospheric Deposition of S, N, Hg on Adirondack Ecosystems	Dr. Dudley Raynal, SUNY College of Environmental Science and Forestry	Adirondack Region	$413,385	$282,598
6485	*Contributions of Global and Regional Sources to Mercury Deposition in New York State	Dr. Christian Seigneur, Atmospheric & Environmental Research, Inc.	Statewide (modeling)	$203,903	$96,805
6486/6490	*Integrated Assessment of the Recovery of Surface Waters from Reduced Levels of Acid Deposition in the Catskills and Adirondacks	Dr. Douglas Burns, US Geological Survey, Dr. Gary Lovett, Institute of Ecosystem Studies	Adirondack and Catskill Regions (modeling and assessments)	$277,186	$245,506
6487	*Status and Effects of Nitrogen Pollution in North Eastern United States	Kathy Fallon Lambert, Hubbard Brook Research Foundation	Statewide	$379,440	$149,320
6488	*Atmospheric Transport and Fate of Mercury in New York State	Dr. Chris Walcek, Research Foundation of SUNY	Statewide (modeling)	$139,099	$102,828
6818	Mercury Deposition Monitoring in the Catskills	Dr. Mike McHale, U.S. Geological Survey	Neversink area, Catskills	$179,738	$116,363

Table 2: New York Energy $mart[sm] Environmental Monitoring, Evaluation, and Protection Program Project Portfolio					
Contract #	Title	Principal Investigator and Research Organizations	Site	Total Project Cost	NYSERDA Cost
6819	*Monitoring Deposition and Effects of Air Pollution in the Hudson Valley	Dr. Gary Lovett, Institute of Ecosystems Studies	Millbrook, NY	$133,333	$100,000
7605	Assessment of Extent to Which Intensively-studied Lakes are Representative of the Adirondack Mountain Region	Dr. Timothy Sullivan, E&S Environmental Chemistry, Inc	Adirondack Region	$2,531,415	$710,787
7606	Potential Recovery of Water Chemistry and Stream Biota from Reduced Acid Deposition at a Sensitive Watershed in the Catskills	Dr. Doug Burns, U.S. Geological Survey	Catskill Region	$63,552	$25,216
7608	Long-term Monitoring and Assessment of Mercury Based on Integrated Sampling using the Common Loon, Prey Fish, Water, and Sediment	Dr. Nina Schoch, Adirondack Cooperative Loon Program/Wildlife Conservation Society	Adirondack Region	$729,090	$380,914
7612/7716	Strategic Monitoring of Mercury in New York State Fish	Dr. Howard Simonin, NYSDEC, Karen Roy, ALSC	Statewide	$714,837	$487,226
7613/7717/ 7718	Assessment of Chemistry and Benthic Communities in Streams of the Oswegatchie-Black River Basins	Dr. Greg Lawrence, U. S. Geological Survey, Karen Roy, ALSC, Dr. Sophia Passy, Univ. Texas	Adirondack Region	$818,575	$476,000
8152	Mercury Deposition Monitoring in the Adirondacks	Dr. Charles Driscoll, Syracuse University	Newcomb, NY	$162,649	$142,658
8644/8739	Regional Forest Health and Stream and Soil Chemistry Using a Multi-scale Approach and New Methods of Remote Sensing Interpretation, Catskill Mountains, NY	Dr. Peter Murdoch, U.S. Geological Survey; Dr. Richard Hallet, USDA Forest Service	Catskill Region	$408,630	$256,553
8646	Assessment of Nitrogen and Acidic Deposition Impacts to Terrestrial and Aquatic Ecosystems of Tug Hill	Dr. Myron Mitchell & Dr. Gregory McGee, SUNY ESF	Tug Hill Region	$167,329	$123,762
8649	Assessing the Sensitivity of New York Forests to Cation Depletion	Dr. Ruth Yanai, SUNY ESF	Statewide	$210,132	$166,043
9059	Wind Power/Wildlife Interaction Project Services ($5,000 EMEP funds, $159,847 SBC Renewables)	Abby Arnold, RESOLVE, Inc	Statewide	$164,847	$164,847
PO-8142	Mercury Matters–General Interest “Science Links” Publication	Hubbard Brook Research Foundation	Northeast	$250,000	$10,000
Total number of Acid Deposition and Mercury research projects: 21				**$20,408,709**	**$9,573,070**

Table 2: New York Energy $mart[sm] Environmental Monitoring, Evaluation, and Protection Program Project Portfolio					
Contract #	Title	Principal Investigator and Research Organizations	Site	Total Project Cost	NYSERDA Cost
Projects Crosscutting the Topics of Air Quality, Health, Ecological Response, and Energy					
6681	*New York City Regional Heat Island Mitigation	SAIC (R. Slosberg), Columbia University (C. Rosenzweig), Hunter College (W. Solecki)	New York City	$134,010	$134,010
7609/8183	Quantifying Atmospheric Nitrogen Sources with New Stable Isotope Techniques	Dr. Carol Kendall, U.S. Geological Survey/Dr. Elizabeth Boyer, SUNY-ESF	Statewide	$649,806	$411,986
7610	*Multi Pollutant Policies for the Electricity Sector and Environmental Quality in the Empire State	Dr. Karen Palmer, Resources for the Future	Statewide	$312,345	$234,261
7615	Analysis of New Pollution Control Strategy Utilizing Emission Reduction Credits and Small Scale Combined Heat and Power Units	Navigant Consulting	Statewide	$101,890	$79,535
7617	Quantifying the Environmental Benefits of Increased Deployment of Combined Heat and Power Technologies in NY State and the Impact of Proposed Emissions Standards for Small Distributed Generation	Navigant Consulting	Statewide	$300,438	$171,863
8642	Ambient Gaseous Ammonia: Evaluation of Continuous Measurement Methods Suitable for Routine Deployment	Dr. James Schwab, SUNY Albany	Albany, Pinnacle State Park, and Addison, NY	$116,671	$89,430
PO-8055	A Synthesis of Climate Change Research	Ecologic: Analysis & Communications	Northeast	$14,000	$14,000
Total number of Crosscutting research projects: 7				**$1,629,160**	**$1,135,085**
Total Funds Committed				**$44,018,201**	**$20,647,369**
Total number of research projects: 46					

*Project complete; project report peer-reviewed and published
**Includes Non-SBC Statutory R&D funds

TABLE 3. EMEP Projects Initiated to Address Research Needs Identified in the EMEP Research Plan

Importance: 1 = critical/extremely important; 2 = important; 3 = moderately important

A. Atmospheric Deposition of Sulfur, Nitrogen, and Mercury, and Ecosystem Response

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
1.0 Baseline Monitoring/Characterization/Surveys				
1.1. Characterize current conditions with respect to baseflow and episodic stream chemistry in sensitive watersheds Statewide to assess the extent and severity of effects, and to establish a baseline from which to assess future recovery.	1	4915	Long-Term Monitoring Program for Evaluating Changes in Water Quality in Adirondack Lakes	Roy
		7613 / 7717 / 7718	Assessment of Chemistry and Benthic Communities in Streams of the Oswegatchie-Black River Basins	Lawrence , Roy, & Passy
		4917	Evaluation of the Recovery from Acidification of Surface Waters in the Adirondacks	Mitchell
		8646	Assessment of Nitrogen and Acidic Deposition Impacts to Terrestrial and Aquatic Ecosystems of Tug Hill	Mitchell & McGee
1.2. Characterize current soil conditions to assess effects and recovery potential of sensitive soils, and develop a soil database that supports other terrestrial and aquatic effects studies. Use historic soil data, where possible, to evaluate long-term changes in soil chemistry.	1	7605	Assessment of Extent to Which Intensively Studied Lakes are Representative of the Adirondack Mountain Region	Sullivan
		8649	Assessing the Sensitivity of New York Forests to Cation Depletion	Yanai
1.3 Develop a strategic monitoring and assessment program on long term trends of mercury deposition and effects, Statewide, to understand the health and environmental consequences of mercury deposition.	1	4916	Mercury in Adirondack/Catskills Wetlands, Lakes, and Terrestrial Systems	Munson & Driscoll
		6818	Mercury Deposition Monitoring in the Catskills	McHale
		8152	Mercury Deposition Monitoring in the Adirondacks	Driscoll
		7612 / 7716	Strategic Monitoring of Mercury in New York State Fish	Simonin & Roy
		7608	Long-Term Monitoring and Assessment of Mercury Based on Integrated Sampling Using the Common Loon, Prey Fish, Water, and Sediment	Schoch
1.4. Monitor biota to evaluate recovery of aquatic food webs from plankton to piscivorous birds.	1	4915	Long-Term Monitoring to Evaluate Changes in Water Quality in Adirondack Lakes	Roy
		7608	Long-Term Monitoring and Assessment of Mercury Based on Integrated Sampling Using the Common Loon, Prey Fish, Water, and Sediment	Schoch
		7612 / 7716	Strategic Monitoring of Mercury in New York State Fish	Simonin & Roy
		6086*	Effects of Atmospheric Deposition of S, N, and Hg on Adirondack Ecosystems	Raynal

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
1.5. Assess the extent of effects of deposition on forest health in geologically sensitive areas of New York State.	1	4917	Evaluation of the Recovery from Acidification of Surface Waters in the Adirondacks	Mitchell
		8646	Assessment of Nitrogen and Acidic Deposition Impacts to Terrestrial and Aquatic Ecosystems of Tug Hill	Mitchell & McGee
		6487*	Status and Effects of Nitrogen Pollution in North Eastern United States	Lambert
		6819*	Monitoring Deposition and Effects of Air Pollution in the Hudson Valley	Lovett
		8644 / 8739	Regional Forest Health and Stream and Soil Chemistry Using an Multi-Scale Approach and New Methods of Remote Sensing Interpretation, Catskill Mountains, NY	Murdoch & Hallet
		8649	Assessing the Sensitivity of New York Forests to Cation Depletion	Yanai
1.6. Develop methodologies to improve accuracy of dry deposition measurements.	1			
2.0 Process-level Studies/Fate and Transport/Ecosystem Cycling/Modeling/Effects				
2.1. Conduct assessments of the effects of acid deposition and Hg on biota and food webs; examine the effects of food web structure on elemental transfers to document biological effects of acid deposition.	1-2	7608	Long-Term Monitoring and Assessment of Mercury Based on Integrated Sampling Using the Common Loon, Prey Fish, Water, and Sediment	Schoch
		7606	Potential Recovery of Water Chemistry and Stream Biota from Reduced Acid Deposition at a Sensitive Watershed in the Catskills	Burns
2.2 Identify multiple sources (including sources outside of NYS) and relative contributions of mercury; determine mercury ecosystem fluxes, transformation and transport, to assist in source reduction initiatives.	2	4916	Mercury in Adirondack/Catskills Wetlands, Lakes, and Terrestrial Systems	Munson & Driscoll
		6485*	Critical Gaps in Research on Mercury in NY State	Seigneur
		6488*	Atmospheric Transport and Fate of Mercury in NYS	Walcek
2.3. Examine interaction of biogeochemical cycles of nutrients (N, S, C, P, Ca) to identify potentially important but indirect effects of acid deposition.	2	6487*	Status and Effects of Nitrogen Pollution in North Eastern United States	Lambert
		6486 / 6490*	Integrated Assessment of the Recovery of Surface Waters from Reduced Levels of Acid Deposition in the Catskills and Adirondacks	Burns & Lovett
		6086*	Effects of Atmospheric Deposition of S, N, and Hg on Adirondack Ecosystems	Raynal
3.0 Synthesis/Integration Studies				
3.1. Investigate landscapes as integrated ecological units by (1) describing linkages among their physical components; (2) examining approaches to extrapolating from small watershed or plot scales to larger units; (3) determining whether the small number of well-studied sites in some parts of New York are representative of larger areas.	1	7605	Assessment of Extent to Which Intensively Studied Lakes are Representative of the Adirondack Mountain Region	Sullivan
3.2. Synthesis and assessment of current	1-2	6487*	Status and Effects of Nitrogen Pollution in North Eastern United States	Lambert

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
information and study site data regarding key issues related to the effects from acid rain and mercury.		6486 / 6490*	Integrated Assessment of the Recovery of Surface Waters from Reduced Levels of Acid Deposition in the Catskills and Adirondacks	Burns & Lovett
3.3. Comprehensive, state-of-science synthesis of acid rain and mercury impacts in New York State.	3	4915	Long-Term Monitoring Program for Evaluating Changes in Water Quality in Adirondack Lakes	Roy
		PO-8142	Mercury Matters–General Interest "Science Links" Publication	Hubbard Brook RF
4.0 Other (Mitigation, Policy/Economic Assessments, Technology Transfer)				
4.1. Conduct modeling to determine critical and target loads.	1-2			
4.2 Assess the effectiveness of cross-sector pollution control strategies in reducing ecological impacts and enhancing recovery.	1-2			
4.3. Assess the economic value of natural resource improvements (aquatic and terrestrial) associated with air pollution control.	2			
4.4. Demonstrate techniques for accelerated recovery.	1-2			

B. Air Quality and Related Health Research: Particulate Matter, Ozone and Co-Pollutants

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
1.0 Ambient Monitoring and Evaluation				
1.1. Develop and integrate improved measurement technologies, including technologies for higher time-resolution composition measurements into network design (2-3 key locations).	2	5060*	Demonstration of Continuous Ambient Particulate Monitor	Patashnick
		6183*	Demonstration of Innovative Instrument for Ambient Particulate Matter Mass Measurement Standard	Patashnick
		8642	Ambient Gaseous Ammonia: Evaluation of Continuous Measurement Methods Suitable for Routine Deployment	Schwab
		6820*	Monitoring Particle Size Distribution in Rochester	Hopke
		6083	Impact of Power Plants on Semivolatile Pollutants and Fine Particles in New York State	Hopke

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
		NYSERDA is supporting several other research projects to address this goal, including the following: development of ultrafine particle monitor at Clarkson, development of a continuous PM speciation monitor with x-ray optical. However, these projects are not funded by EMEP.		
1.2. Develop coarse particle (PM10-PM2.5) monitoring data and source-receptor relations for to help New York State comply with likely course particle standard.	2-3			
1.3. Analyze long-term archived PM filter samples to establish long-term trends, baselines, support source apportionment and transport assessments.	3			
2.0 Fate and Transport				
2.1. Develop, apply and interpret PM/Ozone models and data analysis methods to support policy formulation for PM and ozone management.	1	6083	Impact of Power Plants on Semivolatile Pollutants and Fine Particles in New York State	Hopke
		6084	Source Apportionment of Fine Particles in New York State	Thurston
		4918	Enhanced Measurements of Oxidants, Fine Particles, and Precursors	Demerjian
		7919	Analysis of Particulate Matter Data in New York Using Advanced Source-Apportionment Methods	Hopke
2.2. Improve understanding of the role of primary & secondary organics in PM in New York State.	1	6083	Impact of Power Plants on Semivolatile Pollutants and Fine Particles in New York State	Hopke
		4918	Enhanced Measurements of Oxidants, Fine Particles, and Precursors	Demerjian
		8641	Assessment of Carbonaceous PM2.5 for New York and the Region	Johnson and Graham
		8643	Physical and Chemical Characterization of Laboratory-Generated Secondary Semivolatile Organic Particles	Demerjian
		7616	Chemical Composition of Fine Organic Particles from Urban and Regional Background Locations in New York State	Mazurek
2.3. Improve understanding of transport phenomena, specifically aloft and at night.	1			
2.4. Explore co-pollutant interaction and multi-pollutant effects related to pollution control.	2			

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
2.5. Explore feasibility of alternative air quality management strategies on different time scales (e.g., forecasting and real-time control).	2-3			
3.0 Health Effects				
3.1a. Support the integration and analysis of relevant PM Supersite/network data with exposure/health effects studies.	1			
3.1b. Support the integration of source attribution methods of PM into exposure/health effects studies (methods development, technology transfer) [relates to 2.1].	1	6484	Fine Particle Constituents and Acute Asthma in Urban Areas	Luttinger
		7607*	Workshop on Incorporation of Receptor Models into PM and Adverse Health Effects Studies	Hopke
3.2. Explore feasibility of a targeted cohort study to examine exposure and health effects to "line exposure" from mobile sources.	1			
3.3. Better understand the patterns of, and factors influencing, dose and human exposures to pollutants of ambient origin.	1-2	8650	Ultrafine Particles and Cardiac Responses: Evaluation in a Cardiac Rehabilitation Center	Utell
3.4. Support critical research to identify causal components in PM.	2	4913*	Clinical Studies of Exposure to Ultrafine Particles	Utell
3.5. Develop long-term data for black carbon as surrogate for diesel exposures/Develop exposure data for diesel PM urban environments.	3			
4.0 Source Emissions, Technology and Policy Analysis				
4.1. Support method development and characterization of sources of primary and secondary PM emissions impacting NYS.	1	6230*	Fine/Ultrafine Particulate Emissions Profiles	Drayton & England
		7919	Analysis of Particulate Matter Data in New York State Using Advanced Source Apportionment Methods	Hopke
		NYSERDA is supporting several other research projects to address this goal, including: characterization of emissions from ferries, buses, and the construction sector. However, these projects are not funded by EMEP.		
4.2. Integrated assessment of PM in NYS to	1	4918	Enhanced Measurements of Oxidants, Fine Particles, and their Precursors	Demerjian

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
provide scientific foundation for SIP development.		8641	Assessment of Carbonaceous PM2.5 for New York and the Region	Johnson & Graham
4.3. Develop standard test method for particle size distribution for mobile sector emissions: test stand and in-use	2			

C. Research Needs Crosscutting the Topics of Air Quality, Health, and Ecosystem Response

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
1. Assess adequacy of existing monitoring networks as they relate to (i) source attribution, (ii) determining transport, (iii) evaluating health and environmental effects, and (iv) verifying the impacts of changes to pollution controls strategies on air quality.	1	EMEP did not pursue this area in SBC2, given ongoing federal evaluation of monitoring networks.		
2. Evaluate Environmental Effects and Strategies for Mitigating Impacts of Electricity Generation	1	7610*	Multi-Pollutant Policies for the Electricity Sector and Environmental Quality in the Empire State	Palmer
3. Evaluate the environmental and energy implications of the distributed generation of electricity in New York State.	1	7615	Analysis of New Pollution Control Strategy Utilizing Emission Reduction Credits and Small Scale Combined Heat and Power Units	Greene
		7617	Quantifying the Environmental Benefits of Increased Deployment of Combined Heat and Power Technologies in NYS and the Impact of Proposed Emissions Standards for Small Distributed Generation	Navigant
4. Maintain and initiate, where necessary, measurements of fine particulates/precursors, wet and dry deposition of sulfur and nitrogen, and base cations at specific long-term study sites, building on assessment in C1 above.	1	4915	Long-Term Monitoring Program for Evaluating Changes in Water Quality in Adirondack Lakes	Roy
		4918	Enhanced Measurements of Oxidants, Fine Particles, and their Precursors	Demerjian

Research Target	Importance for NYS	Research Projects Underway (Includes completed projects, noted by *)		
		Contract #	Title	P.I.
5. Identify multiple sources and relative contributions of fixed nitrogen, including ammonia, to NYS ecosystems; examine watershed retention of nitrogen, to assist in source reduction initiatives; improve understanding of the sources of ammonia and role in aerosol formation in NYS - including inventory development and exploration of mitigation options.	1	6487*	Status and Effects of Nitrogen Pollution in North Eastern United States	Lambert
6. Develop evaluation protocols to verify the impacts of pollution control strategies.	2			
7. Assess the feasibility and cost effectiveness of multi-pollutant control strategies for existing generation infrastructure in NYS.	2	7610*	Multi-Pollutant Policies for the Electricity Sector and Environmental Quality in the Empire State	Palmer
8. Evaluate potential effects of emissions trading (e.g., Hg, PM precursors) on local/regional impacts.	3	7610*	Multi-Pollutant Policies for the Electricity Sector and Environmental Quality in the Empire State	Palmer
9. Evaluate the environmental impacts of biodiesel in NYS	2	EPA completed a study to address this topic. It was not pursued under EMEP.		

As discussed at the beginning of Section 3, the Program Advisory Group and Science Advisory Committee are pivotal components of the EMEP process. Table 4 displays the meetings that were held with the two groups to define research needs, develop solicitations, review proposals, and discuss and evaluate progress in EMEP research.

Table 4: Program/Science Advisory Meetings

Date	Purpose
1998	Evaluate six research projects identified in the SBC1 Public Service Commission Order started by the Empire State Electric Energy Research Corporation (ESEERCO) and transferred to EMEP. Provide recommendations for funding.
May 24, 1999	- Develop agenda for the next fall EMEP conference - Convene Technical Evaluation Panel (TEP) for Program Opportunity Notice (PON) 446 - Develop future strategies for EMEP peer review and science/policy integration
December 9, 1999	- Review project portfolio
August 7, 2000	- Convene TEP for PON 540
September 26-27, 2000	- Review project portfolio
March 1, 2001	- Finalize PON 586 - Identify future research target areas and solicitations - Develop strategies for assistance with science/policy communication - Develop agenda for the next fall EMEP conference
June 21, 2001	- Convene TEP for PON 586
September 26, 2001	- Review draft EMEP research plan
June 5, 2002	- Convene TEP for PON 594
October 16-17, 2002	- Review Acid Deposition and Mercury projects
December 11, 2002	- Convene TEP for PON 682
March 18-19, 2003	- Review Fine Particle & Ozone projects
October 9, 2003	- Discuss future EMEP solicitations and planning for the year ahead
June 22, 2004	- Convene TEP for PON 839
December 9-10, 2004	- Review outreach and science policy communication strategies - Explore planning for the future of EMEP - Discuss the structure and function of the PAG/SAC

3.4 Knowledge Synthesis: Highlights of Findings from EMEP Research

The EMEP Program is sponsoring a wide range of energy-related environmental research consistent with the Research Plan. Findings and implications of each project are presented in the individual Project Updates found in Appendix D.

Appendix E presents a *synthesis*, prepared by EMEP staff, of the findings from these projects pertaining to the three EMEP focus areas:

- Air quality and related health research associated with particulate matter, ozone, and co-pollutants;
- Ecosystem response to deposition of sulfur, nitrogen, and mercury; and
- Crosscutting environmental science, energy, technology, and policy projects.

The following boxes highlight some of the key findings from the EMEP program and illustrate where EMEP has advanced the state-of-the-science in key policy relevant areas.

Figure 2: Highlights from EMEP-Supported Projects Related to Air Quality and Health Effects

HOW CAN WE IMPROVE MEASUREMENT OF $PM_{2.5}$ AND ITS COMPONENTS?

- Fine-particle instrument development such as the Sample Equilibration System (SES) Differential Tapered Element Oscillating Microbalance (TEOM) and the Filter Dynamics Measurement System (FDMS) are improving continuous PM measurement by resolving issues with adsorption and evaporation of collected samples. Improved monitors provide a detailed time-series of PM mass that more closely represents fine particles found in the ambient air.

- Field comparisons of the Federal Reference Method (FRM) with the FDMS and beta-attenuation monitor (BAM) show the FRM to be significantly lower than the BAM and FDMS, raising serious questions about the representativeness of the FRM to ambient PM. The designation of the FRM as the mass measurement standard for the "true" ambient PM mass is now being challenged.

- Continuous PM sulfate measurement technologies (R&P 8400S and Thermo 5020) show promise for routine network deployment. PM sulfate measurements are in good agreement with collocated instruments and consistently recover about 80% as much sulfate as 24-hr Speciation Trends Network (STN) filters. Operational and maintenance issues with some systems remain to be resolved.

- Continuous PM nitrate measurement technology (R&P 8400N) shows promise for routine network deployment, but measured PM nitrate levels are significantly lower (30-40%) than other collocated semi-continuous instruments and 24-hr STN filters.

- Continuous PM carbon measurement technology (Sunset Labs-Elemental Carbon/Organic Carbon (EC/OC)) shows promise for routine network deployment, indicating good agreement with collocated instruments and 24-hr STN filters and aerosol mass spectrometer - OC measurements. R&P 5400 EC/OC tracks total relative carbon well, but is not quantitative, as it does not provide comparable EC/OC with 24-hr STN filters.

- Dilution source sampling can be an effective method of measuring PM2.5 emissions from stationary sources. Measurement of PM2.5 emissions is highly method dependent. Emissions tests using different methodologies (e.g., dilution vs. filterable + condensable methods) can produce significantly different results and emission factors. In tests with gaseous fuels (refinery gas and natural gas), filterable + condensable methods yielded PM2.5 emission factors that were one to two orders of magnitude greater than determined using dilution methods. In field and pilot tests with No. 6 fuel oil, conventional stack sampling of filterable + condensable PM2.5 produced PM2.5 emission factors that were between 25% and 60% less than those determined using dilution sampling methods. These tests underscore the need for a consistent measurement method for PM2.5 – established at the national level - combined with a concerted effort to improve PM2.5 emissions inventories and emission factors.

WHAT IS IN $PM_{2.5}$ IN THE NEW YORK REGION?

- The PM Technology Assessment and Characterization Study in New York (PMTACS-NY or "Supersite") research program has measured the temporal and spatial distribution of the $PM_{2.5}$/co-pollutant complex. The findings show that for the annual composition of PM in NYC, the largest fraction is carbon (36%), followed by sulfate (30%), nitrate (15%), and ammonium (15%), with 5% of trace metals/water.

- Composition of $PM_{2.5}$ at NYC (average of New York Botanical Garden, South Bronx, and Queens College measurements), Rochester, Pinnacle State Park, and Whiteface Mountain showed they all have the major components of carbon, nitrate, sulfate, and ammonium but there is a systematic change in the distribution of these components from the urban to the rural and remote locations. Carbon is proportionally highest in the NYC area and lowest in the rural and remote areas indicating an important local component. Nitrate is proportionally highest in the large urban (NYC) and small urban (Rochester) sites, and significantly lower in the rural and remote locations. Sulfate is proportionately highest at Pinnacle State Park, presumably due to its proximity to the Ohio River Valley source region.

- PMTACS also found that the composition of PM changes with season. During summer, wind is generally from the southwest, a region with many coal sources. PM collected during summer has high amounts of sulfate (28%) and organic PM (45%), and lower nitrates (5%). In winter, when there is less photochemistry, the wind is generally from the northeast, an area of fewer regional sources relative to the southwest. During this season, there is less $PM_{2.5}$ mass but it has a higher proportion of nitrate (17%) and higher mass of nitrate.

- PM mass, composition and particle size can vary with day of the week and time of day, revealing important sources and processes. PM mass is greatest in NYC during the morning (6-8 a.m.). Sulfates show almost no diurnal pattern due to transported component. In contrast particle nitrate has peak between 6-7 a.m. Organic PM shows a peak at 5-8 a.m. and again at 3-6 p.m. due to both traffic-related particles and photochemically produced organic PM.

WHAT ARE THE SOURCE REGIONS AND SOURCE TYPES CONTRIBUTING TO PM2.5 IN NEW YORK?

- The geographically separated sites of Queens College, Whiteface Mountain and Pinnacle State Park have similar concentrations of sulfate due to long-range transport of aerosols impacting all three sites similarly. Air mass trajectory analysis

for Queens College, Whiteface Mountain and Pinnacle State Park indicate the Ohio River Valley and area around the Great Lakes as source regions transporting high sulfate concentrations.

- Several different EMEP studies indicate that a large fraction of PM and particulate sulfate is transported into NYC and is not from local sources.

    - While these studies reveal a range in the transported contribution to particulate sulfate (44 to 95%), studies generally agree that more than half of the ambient particulate sulfate in NYC is transported into the region.

    - Studies suggest that on an annual basis approximately 31 to 75% of ambient PM2.5 in NYC is transported into NYC from upwind sources.

    - The transported contribution to PM2.5 and particulate sulfate in NYC can vary depending on season and photochemistry; and the specific quantitative determination of this transport component will be affected by methodological assumptions (e.g., spatial definitions, background reference point.)

- Source apportionment studies for NYC and Upstate New York locations identified secondary sulfate, and the Ohio River Valley as the major source contributing to PM. Soil, secondary nitrate, wood smoke, zinc smelter, copper smelter, nickel smelters, spark ignition vehicles, diesel vehicles, oil combustion, and sea salt were also identified depending on the technique and data sets used.

- Results of Positive Matrix Factorization (a type of source apportionment) using particle number concentrations and size distributions were able to identify major source types and processes including primary industrial emissions, traffic, nucleation. In addition this approach was able to separate residential and commercial heating from other sources such as diesel vehicles.

- Chemical speciation of 63 molecular markers in organic aerosol samples collected upwind, down wind and within New York City have identified three important source types of organic PM. Motor vehicles, using hopanes as the molecular marker are highest in urban areas, and lowest in rural areas. Cooking oil, a less emphasized source type in air quality planning, and identified by n-alkanoic acids, are highest in urban areas during the winter. Photochemical oxidation products identified by C2-C10 diacids are highest in urban areas during spring and summer.

- Estimates of summertime PM production based on OH + VOC measurements suggest that approximately 40% of the PM organic carbon (which can account for close to 20% of PM) can be generated by photochemical oxidation processes (most likely of local origin).

- Estimates of summertime PM sulfate photochemical-production and reaction kinetics of OH + SO_2 indicate that some of the PM sulfate observed at Queens, NY (~15-60%) can be generated by photochemical oxidation processes (most likely of local origin).

- The major source types of PM identified by source apportionment techniques do not have good agreement with the EPA Emissions Inventory for Primary PM, indicating that there may be some problems with the Emissions Inventory for Primary PM in New York City, especially in the soil-related PM component.

ARE THERE SPECIFIC COMPONENTS IN THE PM2.5/CO-POLLUTANT COMPLEX CAUSING ADVERSE HEALTH EFFECTS?

- Clinical health studies on the effects of ultrafine particles (UFP) inhalation showed high pulmonary deposition rates of UFP that increased with exercise, and a number of cardiac effects such as alteration of cardiac repolarization.

- Ultrafine particle (UFP) measurements in Rochester, NY identified diurnal patterns of UFP associated with the morning rush-hour and with afternoon photochemical activity in the spring and summer.

- An analysis of asthma emergency department (ED) visits found $PM_{2.5}$, SO_2, and NO_2 had a statistically detectable impact on acute asthma ED visits in a community with a relatively high baseline rate of acute asthma exacerbations. It is of particular interest that the more robust health impacts were associated with the daily maximum $PM_{2.5}$ concentrations compared to the 24-hour mean, suggesting that peak exposures may have larger health impacts. These associations of the three pollutants with health effects in the Bronx occurred at ambient air levels that are below the current short-term NAAQS.

WHAT ARE THE IMPLICATIONS FOR AIR QUALITY MANAGEMENT OF $PM_{2.5}$ AND OZONE?

- The measured reactions of OH (an indicator of the oxidative strength of the atmosphere) with SO_2 and VOCs, suggest that oxidant control strategies will have a direct benefit in mitigating warm season PM production, underscoring the need for multipollutant control strategies to reduce ambient ozone and PM.

- Summertime photochemical oxidation experiments indicate that local/regional reductions of VOCs (which are gas phase/semivolatile precursors to PM) may be an effective strategy for reducing the organic component of PM2.5, which can be significant in NYC.

- While a large fraction of the annual PM sulfate (44-95%) is transported into NYC - and will therefore necessitate national/regional emission reductions - photochemical oxidation experiments show there is sufficient OH in the summertime to oxidize local SO_2 to PM sulfate (contributing up to 15-60% of PM sulfate in some cases). This suggests that reductions of local SO_2 emissions in the NYC region could potentially further reduce ambient PM2.5.

- Diesel-particulate-filter (DPF) equipped diesel buses and compressed natural gas (CNG) buses show significant reduction in PM emissions as compared to standard diesel buses. CNG-powered buses have methane and formaldehyde emissions that may have to be addressed. In addition, DPF-equipped diesel buses have changed NO_2/NO_x ratios that may have to be addressed. The studies demonstrate that a multi-pollutant approach, combined with appropriate field/in-use testing, is important to avoid unintended consequences with emerging control technologies.

- The findings of “airshed” models underscore that no state in the Northeast can adequately address pollutant problems alone until region-wide control strategies are implemented for ozone and $PM_{2.5}$. The probabilistic framework recommended by these EMEP studies – aimed at integrating the spatiotemporal information of observations and model predictions, and applied to ozone concentrations for demonstration purposes – should be expanded to address multipollutant problems within the “one atmosphere” approach.

Figure 3. Highlights From EMEP-Supported Projects Related to the Deposition of Sulfur, Nitrogen, and Mercury

HOW HAVE REDUCED EMISSIONS OF SULFUR AND NITROGEN RESULTING FROM THE CLEAN AIR ACT AMENDMENTS IMPACTED NEW YORK STATE ECOSYSTEMS?

- Surface waters in New York State affected by acid deposition are slowly improving due to reduced levels of acid precipitation, but additional improvements may require reductions in SO2 and NOx emissions greater than were mandated under the 1990 CAAA. The most recent data from the Adirondacks shows that the rates of improvement have slowed, and the region continues to be at risk.

- The rates of improvement in acid neutralizing capacity in Adirondack lakes are small and slow, suggesting it will take decades at current deposition rates to reach 50 meq/L, a level suitable for aquatic biota.

- Episodic acidification is extremely damaging to Adirondack lake and stream ecosystems. High acidity during snowmelt and high flow events causes aluminum levels to rise, which has been well documented to cause widespread fish mortality. An ongoing EMEP-funded study has found that over 50% of western Adirondack streams have aluminum levels during high flow events that were sufficiently elevated to cause fish mortality.

- Adirondack soil acid-base chemistry has been continuing to deteriorate in most of the acid-sensitive watersheds. It appears that this deterioration in soil condition may have occurred even while lake chemistry was getting better. Such an effect would be expected to restrict the extent to which lakes will be able to recover in the future from acidification and might contribute to future adverse impacts on forest vegetation. Watershed soil is clearly the key to determining the extent to which Adirondack lakes will recover.

- In the Hudson Valley region, fertilized plots show signs of significant increases in foliar and litterfall nitrogen, and nitrate leaching. The surprisingly high nitrate leaching indicates that nitrogen saturation may occur at this site much earlier than expected based on other studies, suggesting that the ecosystem is susceptible to nitrogen saturation.

- While the widespread recovery of streams in the Catskills is as yet unconfirmed, recent data do suggest that recovery may be under way in waters with ANC values in the range of 30–70 ìeq/L. The potential early improvements in stream chemistry may eventually result in the recovery of acid-intolerant biota in affected streams.

WHAT IS THE ROLE OF NITROGEN AND WHAT ARE OUR CONTROL OPTIONS?

- Reactive nitrogen originates from numerous sources and has complex relationships with other pollutants. It therefore requires integrated management strategies and policies addressing multiple rather than individual sources. The assessment of nitrogen pollution in the Northeast region conducted in 2002/2003 shows that the CAAA had not yet had a substantial effect on airborne nitrogen emissions. Together with efforts to reduce SO2, CO2, and other pollutants, nitrogen in the Northeast can be further decreased through a number of strategies: reducing power-plant nitrogen emissions, improving wastewater treatment to remove nitrogen from effluent, reducing the use and increasing the efficiency of

nitrogen fertilizers, and creating and restoring natural nitrogen sinks in wetlands and floodplains.

- Isotopic trace analysis of wet deposition samples shows that the isotopic composition of nitrogen is spatially variable with a gradient from the Midwest (highest isotopic enrichment of ^{15}N) to the Northeast (lowest isotopic enrichment of ^{15}N). The isotopic enrichment is correlated with nitrate, sulfate and pH. These findings, although preliminary, may provide further insight into control strategies for reducing nitrogen loading into the ecosystem.

WHAT HAVE WE LEARNED ABOUT MERCURY EMISSIONS, TRANSPORT AND DEPOSITION?

- Computer modeling conducted in 2001 showed U.S. emissions (non-NYS) to be the largest source of total Hg deposition in New York State. Dry deposition was dominated by NYS and U.S. emissions, while wet deposition showed a much greater contribution from sources outside North America.

- Hg transport within and around NYS, and consequently the effects of individual point-source emissions on Hg deposition in NYS, are strongly influenced by small-scale meteorological features. As a result, fairly high resolution modeling of the air flows in NYS would be needed in order to accurately assess the impacts of point sources of mercury on deposition in NYS.

WHAT HAVE WE LEARNED ABOUT THE FORMS OF MERCURY AND THEIR IMPACT ON NEW YORK STATE?

- The dynamics of Hg studied within forest plots at an Adirondack watershed showed that the flux of Hg to the forest ecosystem was dominated by dry deposition, which was estimated as throughfall (water that falls to the ground following interaction with the forest canopy) plus litter fall. These inputs accounted for 70% of total deposition. Current data on mercury dry deposition are extremely limited, underscoring a significant gap in the ability to assess the effectiveness of mercury control strategies.

- A monitoring project measuring reactive gaseous mercury, particulate Hg, and Hg in wet deposition has begun characterizing the forms of Hg in New York's ambient air and its sources. This initial project and its instrument comparison will become the basis of New York's future Hg monitoring network.

IS MERCURY AFFECTING WILDLIFE IN NEW YORK STATE?

- 18% of the loons sampled in the Adirondacks are estimated to be at risk for harmful effects from mercury contamination.

- Fish and water samples collected from 131 lakes across New York State has resulted in the addition of numerous waterbodies, including all waters of the Adirondacks and Catskills, to the NYS Department of Health has fish consumption advisories.

Figure 4. Highlights From Completed EMEP-Supported Projects Crosscutting the Issues of Air Quality, Health, Ecological Response, and Energy

HOW WILL PLANNED NATIONAL AND REGIONAL PROPOSALS TO REDUCE EMISSIONS FROM THE ELECTRICITY SECTOR AFFECT NEW YORK STATE AND THE NATION?

- In 2004 an assessment was conducted of several proposed regional and national emission control strategies to reduce SO2, NOx, and mercury including: (i) the Clean Air Interstate Rule (CAIR) combined with a mercury cap; (ii) CAIR combined with a mercury cap and seasonal SIP NOx policy; (iii) CAIR plus a tighter mercury control using Maximum Achievable Control Technology (MACT); and (iv) CAIR plus a tighter mercury standard with trading. The study concluded that the benefits to the nation and to New York State significantly outweigh the costs associated with the proposed reductions in SO_2, NOx, and mercury. All policies evaluated showed dramatic *net* benefits underscoring the rationale for further national/regional reduction in emissions from power plants.

- Contrary to EPA's initial findings, CAIR as originally proposed by itself would not keep summer emissions of NOx from electricity generators in the SIP region below the current SIP seasonal NOx cap. [In the final CAIR, EPA added a seasonal NOx cap to address seasonal ozone problems.] CAIR with the seasonal NOx cap produces higher net benefits.

- The study also illustrated that the manner in which mercury emissions are regulated will have important implications not only for the cost of the regulation, but also for emission levels and emission locations for SO_2 and NOx. The evaluation of scenarios with tighter mercury emission controls shows that the net benefits of a maximum achievable control technology (MACT) standard exceed the net benefits of a cap and trade approach.

ARE THERE OPTIONS FOR MITIGATING THE URBAN HEAT ISLAND EFFECT IN NEW YORK CITY?

- Significant reductions in New York City's near-surface air temperature can be achieved by implementing heat island mitigation strategies.

    - Street trees—which involve redevelopment of impervious surfaces—have the largest cooling potential per unit area, followed by living roofs, light-colored surfaces, and open-space planting.

    - Taking into consideration available land area and other physical constraints, combined strategies such as urban forestry + living roofs and urban forestry + lights roofs have the greatest city-wide modeled temperature impacts (0.7^{o}F and 0.6 ^{o}F respectively). Of the single strategy scenarios, light surfaces had the greatest temperature impact (0.4 ^{o}F).

    - Light surfaces, light roofs, and curbside planting are more cost-effective than other strategies.

- The choice of a strategy should consider the characteristics and priorities of the neighborhood, including benefit/cost factors and the available area for implementation of each strategy.

Section 4: Knowledge Dissemination and Information Exchange

This section discusses the dissemination of knowledge and information exchange from specific EMEP program activities, including, where known, quantification of the extent of the activity.

4.1 Overview of Communications Activities

EMEP places a premium on communicating research results to the target audiences. EMEP employs a variety of communication strategies and approaches as highlighted below. In 2002, EMEP program staff developed a Communications Strategy, with the assistance of outside contractors. This Communications Strategy was adjusted as needed and established the framework for the bulk of EMEP communications activities [see Appendix F]. In 2005, EMEP surveyed two dozen representative user groups to refine its Communication Strategies. The results of this recent survey will be used to develop the EMEP Communications Strategy for the next phase of the EMEP program.

Electronic communications have become more and more important in recent years. Table 5 below lists the number of hits on EMEP Web pages, by month; Table 6 shows the top 20 items downloaded from the EMEP site since March 2005, when EMEP first had its own presence on the NYSERDA Web site. A revised and improved EMEP Web site was launched in October 2005.

Table 5: EMEP Web Site Hits by Month and Year

Month	Hits	2005 Total	Month	Hits	2006 Total
March 05	546		January 06	12,546	
April 05	468		February 06	13,642	
May 05	1,147		March 06	18,856	
June 05	965		April 06	28,422	
July 05	2,308		May 06	29,141	
August 05	2,211		June 06	20,068	
September 05	3,610		July 06	18,897	
* October 05	6,703		**2006**		**141,572**
November 05	6,893				
December 05	9,761				
2005		**34,612**			

* The revised EMEP Web site was launched in October 2005.

From November 2005 through July 2006, the EMEP Web site has been one of the top three NYSERDA Web pages (as determined by number of hits on each page). From March 2006 through July 2006, two of the top five NYSERDA Web pages have been EMEP pages.

Table 6: Top 20 Downloads from March 2005 through June 2006

Item	# of Downloads
Fine and Ultrafine Particulate Emission Profiles: Critical Review of Methodologies (Project #6230)	8181
Acid Rain primer	5785
Multipollutant Policies for the Electricity Sector and Environmental Quality in the Empire State: Final Report (Project #7610)	4066
Fine and Ultrafine Particulate Emission Profiles: Test Results for a Cogeneration Plant with Supplementary Firing, Oxidation Catalyst, and SCR at Site Golf (Project #6230)	3704
Fine and Ultrafine Particulate Emission Profiles: Conceptual Model of Sources of Variability in Combustion Turbine PM10 Emissions Data (Project #6230)	3695
Fine and Ultrafine Particulate Emission Profiles: Impact of Operating Parameters on Fine Particulate Emissions from Natural-Gas-Fired Combined Cycle and Cogeneration Power Plants (Project #6230)	2523
Fine and Ultrafine Particulate Emission Profiles: Pilot-Scale Dilution Sampler Design and Validation Tests (Laboratory Study) (Project #6230)	2306
2005 EMEP conference agenda	1982
Fine and Ultrafine Particulate Emission Profiles: Test Results for a Gas-Fired Process Heater (Site Alpha) (Project #6230)	1730
Atmospheric Transport and Fate of Mercury in New York State: Final Report (Project #6488)	1674
Topical Rept: Test Results for a Gas-Fired Process Heater with Selective Catalytic NOx Reduction (Site Charlie) (Project #6230)	1295
EMEP program plan	1201
Fine and Ultrafine Particulate Emission Profiles: Fine particulate test protocol (Project #6230)	1086
Fine and Ultrafine Particulate Emission Profiles: Test Results for a Dual-Fuel-Fired Commercial Boiler (Site Delta) (Project #6230)	1077
2003 conference pres: Afonso (emission control technologies)	939
2003 conference proceedings	894
Innovative Instrument for the Measurement of Ambient Particulate Matter: Final Report (Project #6183)	781
Effects of Atmospheric Deposition of Sulfur, Nitrogen, and Mercury on Adirondack Ecosystems: Final Report (Project #6086)	712
EMEP fact sheet	629
Fine and Ultrafine Particulate Emission Profiles: Final Report (Project #6230)	598

- Since its inclusion on the EMEP Web site in October 2005, the Acid Rain Primer has been one of the top three EMEP downloads every month.

- Of the 49,000 total downloads from EMEP sites from March 2005 through June 2006, 55% were related to contract 6230, which looked at the development of methods for measuring and characterizing fine and ultrafine particle emissions from different sources.

Table 7 lists the communications activities supported by EMEP; for more detailed information on any of the listed activities, please see the EMEP Web page (http://www.nyserda.org/programs/Environment/EMEP/index.asp).

Table 7: EMEP Science & Policy Communication Activities: 1998-2006

Product	Total Number	Date	Focus	Attendees	Target Audience
Conferences, Workshops, Seminars					
EMEP Conferences: Linking Science and Policy	**4**	Dec 7–8, 1999	Linking Science and Policy	184	Scientists, policy makers/ analysts, public interest groups, industry
		Sept 24–25, 2001	Future Directions for a Multipollutant and Multimedia Environmental Protection Strategy (21 posters)	214	
		Oct 7–8, 2003	Science and Policy Issues Related to Nitrogen in the Environment / Increasing the Effectiveness of Science-Policy Communication (46 posters)	234	
		Oct 25–26, 2005	Science and Policy Issues Related to Mercury in the Environment and to Climate Change (48 posters)	267	
Conferences Co-Funded by EMEP	**3**	May 2–3, 2001	Acid Rain: Are the Problems Solved? Washington, D.C.	100	U.S. legislators
		Mar 31–Apr 4, 2003	American Association for Aerosol Research (AAAR) meeting—Particulate Matter: Atmospheric Sciences, Exposure, and the 4th Colloquium on PM and Human Health	550	Scientists, EPA
		Feb 7–11, 2005	AAAR Supersites Program and Related Studies International Specialty Conference	400	Scientists, EPA
Workshops Co-Funded by EMEP/ Briefings Organized by EMEP	**6**	Apr 29–30, 2002	North American Research Strategy for Tropospheric Ozone (NARSTO) Executive Assembly meeting & workshop: Status Report on the PM Assessment and Reviews of the EPA Supersite Program	35	Researchers and agencies involved in the PM Supersite Program
		May 28–30, 2003	Workshop on the Source Apportionment of Particulate Matter Health Effects: Intercomparison of Results and Implications, Arden Conference Center, Harriman, NY (7616)	30	Scientists, policy makers/ analysts
		2000, 2001, 2003, 2004	Environmental Stakeholders meetings	20	Public interest groups, policy analysts
Training Sessions	**2**	Summer 2003	Workshop on Source Apportionment & Health Effects and Review & Training Session on Positive Matrix Factorization and UNMIX Receptor Modeling Package	25	NYS DEC scientists & analysts
		May 24, 2006	Source Apportionment: Positive Matrix Factorization Training Session	11	NYS DEC scientists & analysts

Table 7: EMEP Science & Policy Communication Activities: 1998-2006 (continued)

Product	Total Number	Date	Focus	Attendees	Audience
Program/ Science Advisory Meetings	**14**	1999–2004	Discussion of various EMEP projects, conferences, and future plans *(Summarized in Section 3)*	15-20	EMEP Program Advisory Group and Science Advisors
EMEP Research Plan Development Meetings	**2**	July 2001	Development of a plan to fill critical gaps and identify research priorities	35	Scientists, policy analysts, regulators
Project Review Meetings	**~90**	July 1998–July 2006	Meetings with principal investigators to discuss project progress & findings, including site visits	N/A	NYSERDA, research team
Publications					
Summary Communications	**4**	2003	Nitrogen Pollution: From the Sources to the Sea		Scientists, policy makers/ analysts
		Oct 2003	Developments in Continuous Fine Particle Mass Monitoring: Sample Equilibration and Differential Particle Sampling		
		Dec 2003	Transboundary Pollution: Ozone and Fine Particulate Matter in the Northeast		
		Oct 2005	Reducing Emissions from the Electricity Sector: The Costs and Benefits Nationwide and in the Empire State		
EMEP Newsletter	**3**	Summer 2003: EMEP research priorities, nitrogen pollution Spring 2004: NY acid rain controls, water quality projects, air pollution monitoring projects Spring 2006: Adirondack soil chemistry, new emissions sampling method			Policy makers/ analysts, public interest groups, industry, scientists
EMEP Final Project Reports	**16**	**Atmospheric Deposition of S, N, and Hg, and Ecosystem Response**			
		June 2002	Contributions of Global and Regional Sources to Mercury Deposition in NYS		Scientists, policy makers/ analysts, public interest groups, industry stakeholders
		Apr 2003	Status and Effects of Nitrogen Pollution in Northeastern US		
		Sept 2004	Effects of Atmospheric Deposition of Sulfur, Nitrogen, and Mercury on Adirondack Ecosystems		
		Feb 2005	Monitoring the Deposition and Effects of Air Pollution in the Hudson Valley, NY		
		July 2005	An Assessment of Recovery and Key Processes Affecting the Response of Surface Waters to Reduced Levels of Acid Precipitation in the Adirondack and Catskill Mountains		
		July 2005	Atmospheric Transport and Fate of Mercury and its Impact on New York State		
		Oct 2005	Acid Rain and the Adirondacks: A Research Summary		

Table 7: EMEP Science & Policy Communication Activities: 1998-2006 (continued)

		Air Quality and Related Health Research: Particulate Matter, Ozone and Co-Pollutants		
		Oct 1999	Least Cost Control Strategies to Reduce Ozone in the Northeast	Scientists, policy makers/ analysts, public interest groups, industry stakeholders
		Oct 2002	A Survey of Monitoring Instruments for Measurement of Airborne Pollutants	
		Jan 2003	Assessing the Effects of Transboundary Pollution on New York's Air Quality	
		Oct 2003	Develop and Field Test Rupprecht and Patashnick Series-6400 Controlled Sampling Continuous Particulate Monitor	
		Oct 2003	Innovative Instrument for an Ambient Air Particulate Mass Measurement Standard	
		Nov 2003	Analysis of Ozone and Fine Particulate Matter in the Northeastern United States	
		Oct 2004	Development of Fine Particulate Emission Factors for Oil- and Gas-Fired Combustion Systems	
		June 2005	PM2.5 Technology Assessment and Characterization Study in New York	
		Research Crosscutting the Topics of Air Quality, Health, and Ecosystem Response		
		May 2005	Reducing Emissions from the Electricity Sector: The Costs and Benefits Nationwide and in the Empire State	Scientists, policy makers/ analysts, public interest groups, stakeholders
Primers	**3**	Acid Rain: Learning from the Past and Looking to the Future		Students, general public, policy makers
		Air Pollution in New York State: Ozone and Particulate Matter		
		Mercury Deposition (forthcoming)		
Peer-Reviewed Publications on EMEP Research *				
Peer-Reviewed Publications	**158**	Encompass journal articles, book chapters, and papers published in peer-reviewed conference proceedings. There have been 123 peer-reviewed publications since EMEP's inception. 35 more are presently in preparation, in review, or in press.		Research scientists, policy analysts

***** Principal investigators in the EMEP program have presented findings in hundreds of venues, including technical conferences, community workshops, congressional hearings, and schools, including K–12 programs and university seminars.

4.2 Relevance, Acceptance, and Use by the Scientific Community

Publication in peer-reviewed journals serves as the primary means of assessing acceptance and use by the scientific community. While simply counting the number of publications in the literature can skew the real value and impact of research, it is one proxy for the acceptance of research by the scientific community.

To date, 123 peer-reviewed publications have arisen from EMEP research, with another 35 currently in the process of being published. Appendix G provides a detailed list of these publications. Articles have been published in a variety of journals. The most frequent journals for publication of EMEP research include:

Atmospheric Environment
Journal of the Air and Waste Management Association
Journal of Geophysical Research
Aerosol Science and Technology
Environmental Science & Technology
Hydrologic Processes
Environmental Pollution
Water Air Soil Pollution
Journal of Applied Meteorology

Analysis of the co-authors of EMEP research papers illustrates the highly collaborative nature of the EMEP research program, with scientists from over a dozen countries participating in these New York-based projects and co-authoring research papers (see Appendix G, Table 3).

A citations analysis was also conducted to assess the subsequent use of the EMEP research by the scientific community. The citations analysis was conducted by Thomson Scientific in 2006. Ninety eight of the EMEP publications were found in their citations database. These papers were sited in peer-reviewed journals 655 times between 1999 and 2005 (Figure 5). The papers were also assessed to determine the degree of impact measured as the average number of citations for a particular journal divided by the actual number of citations for the specific article. Across all EMEP articles, the ratio was 1.3 indicating that the papers were cited more than expected. Papers with the highest impact ratio are shown in Table 8. As can be seen from Table 8, a number of these "high impact" papers resulted from the PM Supersite project and the EMEP project to characterize fine particle and ultrafine particle emissions from combustion sources.

Figure 5: Citations of EMEP Research Papers

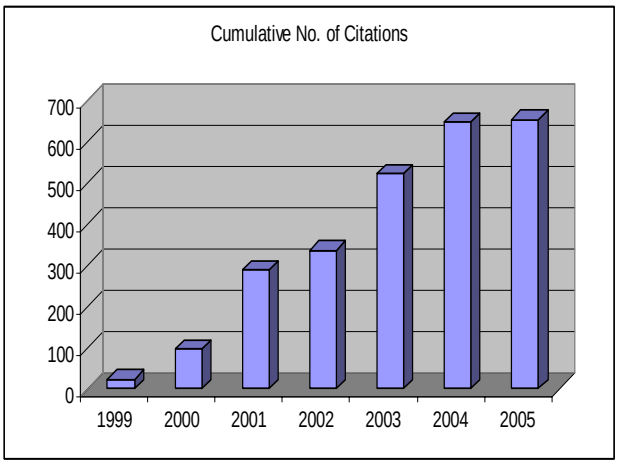


Table 8. Papers with the Highest Impact Ratio (Expected No. of Citations Versus Actual No. of Citations)

No. of Citations	Expected No. of Citations	Impact Ratio	Author	Journal	YR	Title
23	2.8	8.2	Canagaratna, MR	AEROSOL SCI TECH	2004	Chase studies of particulate emissions from in-use New York City vehicles
27	3.6	7.5	Daigle, CC	INHAL TOXICOL	2003	Ultrafine particle deposition in humans during rest and exercise
18	2.8	6.4	Drewnick, F	AEROSOL SCI TECH	2004	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part I: Mass concentrations
2	0.4	5.6	Chang, MCO	J AIR WASTE MANAGE	2004	Measurement of ultrafine particle size distributions from coal-, oil-, and gas-fired stationary combustion sources
5	1.0	4.8	Hogrefe, O	J AIR WASTE MANAGE	2004	Semicontinuous PM2.5 sulfate and nitrate measurements at an urban and a rural location in New York: PMTACS-NY summer 2001 and 2002 campaigns
13	2.8	4.6	Drewnick, F	AEROSOL SCI TECH	2004	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part II: Chemically speciated mass distributions
13	2.9	4.5	Bischoff, JM	WATER AIR SOIL POLL	2001	N storage and cycling in vegetation of a forested wetland: Implications for watershed N processing
10	2.8	3.6	Kim, E	J GEOPHYS RES-ATMOS	2004	Improving source identification of fine particles in a rural northeastern US area utilizing temperature-resolved carbon fractions
18	5.1	3.5	Ren, XR	ATMOS ENVIRON	2003	OH and HO2 chemistry in the urban atmosphere of New York City
12	3.6	3.4	Utell, MJ	INHAL TOXICOL	2002	Cardiovascular effects associated with air pollution: Potential mechanisms and methods of testing

4.3 Relevance, Acceptance, and Use by Policy/Decision Makers and Impacts on New Policies, Regulations, and Resource Management Decisions

This section highlights how EMEP projects have affected energy-related environmental policy to date. The section also highlights areas where EMEP data/studies have been identified as providing critical information to support future policy development and evaluation. Table 9 below highlights some of the EMEP-related briefings that have been given to policymakers.

✓ MERCURY:

- EMEP research has brought to light the vast extent of mercury contamination in fish in waters across New York State. EMEP monitoring data have resulted in one of the largest changes in the fish consumption advisories by the Department of Health in over a decade. *[NYS Department of Health Fish Consumption Advisory, April 2005]*

- EMEP mercury research was used in determining the need for a New York State rule for mercury control from power plants. Relevant EMEP research used by the NYS DEC included: mercury transport and source attribution modeling, wet deposition monitoring data, mercury surveys in fish and loons *[NYS DEC presentation, Stakeholder Meeting for Proposed Rules on Mercury Reduction Program for Coal-Fired Electric Steam Generating Units, July 17, 2006]*

- EMEP mercury data were cited by the Northeast States for Coordinated Air Use Management (NESCAUM) in their comments on the proposed EPA Mercury Rule. *[Comments to Docket Number OAR-2002-0056]*

✓ ACID DEPOSITION:

- Data from the Adirondack Lakes Survey Corporation's (ALSC) Long-Term Monitoring project, of which EMEP is the primary funder, and from the EMEP-funded Adirondack Cooperative Loon Project have been used as the supporting technical rationale for New York's Acid Deposition Reduction Program. *[NYS DEC, public hearing statement, October 14, 2004; and NYS DEC Response to Comments Regarding the Adoption of the Acid Deposition Reduction Program, January 2005]*

- EMEP-sponsored data have also been cited by the U.S. EPA as supporting technical information in evaluating the Clean Air Act Amendments of 1990 *[Response of Surface Water Chemistry to the Clean Air Act Amendments of 1990 - EPA 620/R-03/001, January 2003]* and the Clean Air Interstate Rule

[Benefits of the proposed Interstate Air Quality Rule - EPA 452/-03-001, January 2004]

✓ FINE PARTICLES AND OZONE:

- EMEP data on fine particle emissions from stationary natural gas combustion were used to update the National Emissions Inventory, which is the basis for air quality management plans in New York State and the U.S. *[U.S EPA, NEI Listserv, August 11, 2005, Revised PM emissions in the 2002 NEI for natural gas combustion]*

- Results on the speciation of PM2.5 and role of PM precursors from the Supersites programs, including early results of the NY Supersite, were used in EPA's consideration of the Transportation Conformity Rule Amendments for the New PM2.5 National Ambient Air Quality Standard: PM2.5 Precursors. *[40 CFR Part 93, OAR-2003-0049]*

- EMEP analysis has led to an improved method for treating the uncertainties reported in the Fine Particle Speciation Trends Network (STN). *[U.S. EPA Communications to Receptor Model Workgroup, July 19, 2006]* The STN data will be used in developing fine particle air quality management plans, with New York's State Implementation Plans due in 2008.

- Monitoring research projects such as the EMEP funded NY Supersite will be used to evaluate modeling tools and are expected to significantly increase confidence in the reliability of these air quality planning tools over the next few years. *[personal communication, EPA Supersite Technical Lead]*

- EMEP has supported development of the Fluid Dynamic Measurement System (FDMS), based on Rupprecht & Patashnick's (now Thermo Electron) tapered element oscillating microbalance (TEOM) for semi-continuous measurement of fine particles. USEPA has approved the use of the FDMS by state and local air monitoring agencies as part of the AirNow network for fine PM. In addition, the State of California has recognized the FDMS as a California approved sampler method.

- EMEP-funded ozone and PM research has become central to EPA's science and policy approach with respect to addressing long-range transport, the need for long-term modeling for SIPs, and how models are to be used for making policy. [*EPA/PAG member, personal communication, July 2006*]

- EMEP research was used to update EPA's Guidance on Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS and more recently to was used in EPA's Technical Support Document for the Final Clean Air Interstate Rule, Air Quality Modeling.

- EMEP research advanced the concept of an “airshed” for ozone and PM management - a concept that has now been embraced in a National Academy of Science report which recommends that new regulations consider how air pollution travels from state-to-state. *[National Academy of Sciences, Air Quality Management in the United States, January 2004]*

- Several EMEP research projects are providing the scientific foundation for the development of a PM2.5 State Implementation Plan, which will ultimately affect utilities and other fossil fuel combustion systems in New York.

HEALTH EFFECTS:

✓ SULFUR DIOXIDE:

- The New York State Department of Health recommended that EMEP findings on the effects of short-term SO2 exposure on asthma be considered in EPA’s current review of the SO2 national ambient air quality standard *[Docket ID EPA-HQ-ORD-2006-0260]*

Table 9: Highlights of EMEP-Related Briefings to Policymakers			
Date	Presenter(s)	Attendees	Subject
Fine Particle and Ozone Research			
	Dan Luttinger	NYSERDA and NYS Department of Health (DOH) staff	DOH Asthma study
May 30, 2002	Ken Demerjian et al.	NYSERDA and NYSDEC staff	1) NYS supersite program 2) Compare & contrast urban & rural aerosols & chemical compositions 3) Preliminary results of bus-chase studies
October 2002	Glen England	EPA Emission Inventory Group	PM2.5 Emission Factors and Speciation Profiles for Gas-Fired Combustion Sources
January 22-23, 2003	Ken Demerjian	EPA, NYS, researchers, etc.	Briefing at EPA PM Supersites Meeting in Atlanta
May 2003	Phil Hopke	DEC air modeling staff	Training session on source apportionment techniques
May 1, 2003	Ken Demerjian	NYSERDA, NYSDEC, Department of Transportation, DOH, and Environmental Energy Alliance staff	Joint enhanced ozone and PM2.5 technology assessment and characterization study in NY (PMTACS-NY)
July 29, 2003	Ken Demerjian	New York City Metropolitan Transportation Authority	Particle and gaseous emission testing of diesel and compressed natural gas (CNG) buses in NYC
July 31, 2003	NYSERDA EMEP Staff and Ken Demerjian	EPA Region II staff	1) Briefing on EMEP program and key findings 2) PM2.5 technology assessment and characterization study in NY (PMTACS-NY)
January 27-29, 2004	Monica Mazurek	MARAMA-MANE-VU Science meeting	Chemical Composition of Fine Organics
February 11, 2004	George Thurston	NYSERDA and NYSDEC staff	Source Apportionment of PM in NYC
April 5-7, 2004	Monica Mazurek	International State of the Science Workshop on Organic Speciation at DRI	Chemical Composition of Fine Organics
April 12, 2004	Ken Demerjian		1) Carbonaceous PM2.5: Lessons learned from the NY Supersite 2) Carbonaceous PM: The state of the science

Table 9: Highlights of EMEP-Related Briefings to Policymakers (continued)			
Date	Presenter(s)	Attendees	Subject
April 20-23, 2004	Monica Mazurek	United Nations Economic Commission for Europe, Convention on Long-Range Transboundary Air Pollution Cooperative Program for Monitoring & Evaluation of the Long-Range Transmission of Air Pollutants in Europe, U.S. EPA, Environment Canada, international researchers	Workshop on Particulate Matter, Measurement, & Modeling
June 15, 2004	Ken Demerjian and Supersite collaborators	Research team, funders, DEC, DOH, NYSERDA staff	PMTACS-NY winter-intensive review
November 17, 2004	Ken Demerjian	NYSERDA, NYSDEC staff	Joint enhanced ozone and PM2.5 technology assessment and characterization study in NY (PMTACS-NY)
June 16, 2005	Philip Hopke and Tom Holsen	NYSERDA and NYSDEC staff	Semivolatile Project update on sources and mercury briefing
May 23, 2006	Phil Hopke	NYERDA, NYSDEC, and DOH	Briefing on results of PMF modeling of NYS sites
July 2006	Paul Solomon	EPA	Will submit a report on the Supersites program for Congressional Performance Review
Acid Deposition and Mercury Research			
Spring 2001	Charles Driscoll	U.S. Congressional Staff	Workshop on the computer model calculations used in acid deposition studies
May 3, 2001	Charles Driscoll	U.S. House of Representatives Science Committee	Hearing on Acid Rain—The State of the Science and Research Needs for the Future
October 12, 2004	Karen Roy	NYSDEC staff	Legislative public hearings on proposed rules to reduce emissions of NOx and SO2 from fossil-fuel-fired electric generating sources statewide through market-based cap-and-trade programs
September 27, 2005	Karen Roy	Standing Committee on Environmental Conservation Adirondack Water Quality	Public hearing on the status of acid deposition effects in the Adirondacks
Crosscutting Research			
June 13, 2005	NYSERDA EMEP staff	Department of Public Service staff	Energy-related environmental issues
October 27, 2005	USGS PIs	NYSERDA and NYSDEC staff	Nitrogen Isotope briefing
February 16, 2006	NYSERDA staff	NYS Attorney General's Office	Briefing on EMEP program

Section 5: Other Potential Elements of Program Impact Evaluation

5.1 Commercialization Progress: Not Applicable to the Current EMEP Evaluation

Of the 46 projects in the current EMEP portfolio, two projects seek to develop technology and commercialize a product. [See Appendix D Fact Sheet on air quality project 5060, "Developments in Continuous Fine Particle Mass Monitoring."] These products are now being sold commercially and have been approved for use by the USEPA and the California Air Resources Board. NYSDEC has deployed several of these instruments into its monitoring network.

These EMEP commercialization efforts were evaluated in 2004 (Appendix H). Results of the evaluation were reported in the May 2005 New York Energy $mart^{SM} Program Evaluation and Status Report. The peer reviewers concluded that the projects are providing substantial benefits.

Since existing EMEP commercialization efforts were previously evaluated by an independent panel, Commercialization Progress will not be further assessed in this 2006 evaluation.

5.2 Quantification of Energy, Economic, and Environmental Benefits: Not Applicable to the Current EMEP Evaluation

In general, NYSERDA seeks to quantify the energy, economic, and environmental benefits associated with its public-benefit programs, ideally in terms of kWh of energy saved, economic benefit to New Yorkers ($), and tons of pollutants reduced.

Given the nature of the EMEP research programs, a *quantitative* attribution of energy, economic, and environmental benefits resulting from EMEP was not feasible for this 2006 review.

Some desired outcomes which could *potentially* be quantified include:

- Increased NYS capability to address critical environmental issues and increased funding sources available
  - Change in NYS's capability to address critical environmental issues
  - Change in level and stability of funding being made available for environmental research in NY and description of the focus

- Realized Economic Benefits:
  - Status of commercialization of relevant items and quantification of associated environmental and health benefits that have been realized for NY businesses and citizens {previously reviewed in 2005}

- Potential Environmental and Health Benefits
  - Quantification of associated environmental and health benefits that may be achieved in the future as a result of projects supported through NYSERDA's program.
  - The primary vehicle for EMEP to achieve real-world environmental improvements is through its impact on development of environmental policies, regulations, and guidance. As described in Section 4.3, EMEP data and research have already had an impact on State and National environmental policies, regulations, and guidance.

For the majority of these parameters, quantification of benefits attributable to EMEP would require considerable resources. NYSERDA, with its Evaluation Contractors, will explore potential ways to quantify such EMEP-related benefits where possible. NYSERDA welcomes the input of the peer review panel in this matter.