

# **FEDERAL AIR QUALITY RESEARCH 1998-2000**



**Prepared by**

**COMMITTEE ON THE ENVIRONMENT AND NATURAL RESOURCES  
AIR QUALITY RESEARCH SUBCOMMITTEE  
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## OVERVIEW

The Air Quality Research Subcommittee of the Committee on the Environment and Natural Resources (CENR) has identified in its Strategic Plan<sup>1</sup> the five most pressing air quality issues that face the Nation today. It is in these areas that new and innovative approaches are most urgently needed if we are to manage air quality while sustaining economic growth.

1. Particulate matter and visibility
2. Ozone and associated air pollutants
3. Acidic deposition
4. Hazardous air pollutants
5. Indoor air quality

Clearly, these issues are not completely independent and many of the associated phenomena are interrelated. For example, the same complex chemistry that produces ozone also results in the formation of fine particles and the acids responsible for acidic deposition. The Subcommittee, in recognition of these connections, has recently added a sixth area of research focus.

6. One atmosphere

Research conducted under the “one atmosphere” category includes activities that explore the connections and commonalities among the first five issues by taking a more holistic approach and strives to identify integrated approaches to air quality management.

The Subcommittee works to direct federal research and development investments in a manner that serves to maximize the benefits of individual departmental and agency programs while promoting a collaborative approach to the development of the needed information. The research program described is an integration of the unique perspectives, capabilities and facilities of member agencies consistent with their individual missions and responsibilities and with priorities established jointly through the Subcommittee.

Concern over ground-level ozone and fine particles continues to dominate the Nation’s air quality agenda and therefore are most prominent in the federal air quality research portfolio. The scope of NARSTO (a public/private partnership formerly known as the North American Research Strategy for Tropospheric Ozone) has been expanded from its original focus on ground-level ozone to include fine particle research. This organization provides an effective mechanism for collaboration and cooperation on ozone and fine particle research. The Federal and private sectors have worked together, through NARSTO, to produce a state-of-science assessment for ozone and are planning a similar

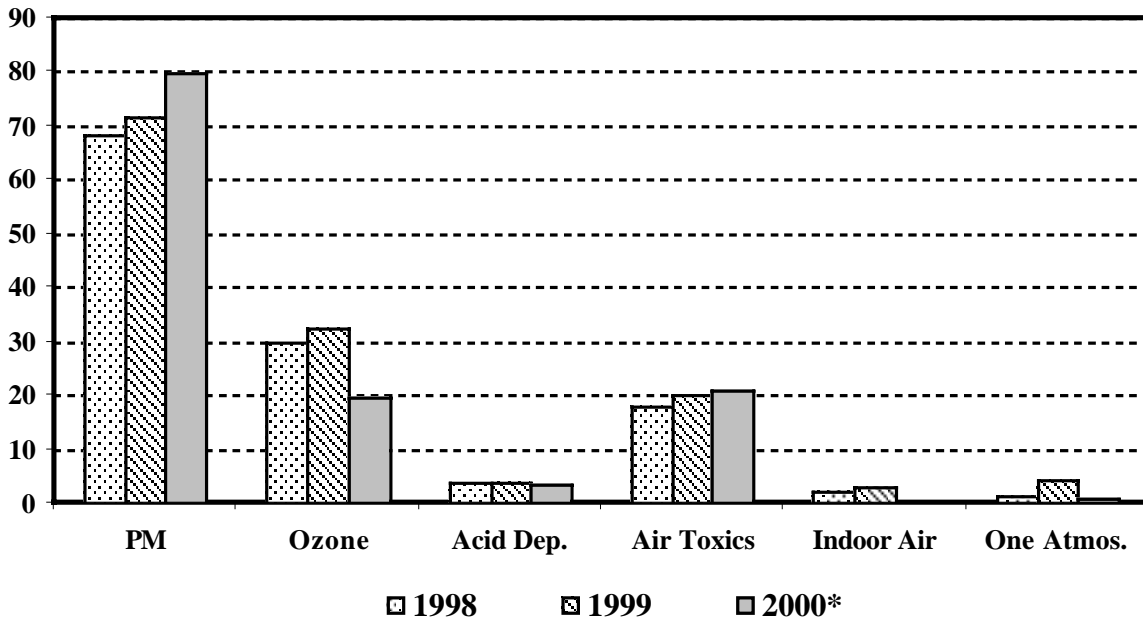
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<sup>1</sup> Air Quality Research Subcommittee Strategic Plan, Committee on Environment and Natural Resources, National Science and Technology Council, Washington, D.C., November 1998

effort for fine particle research. These assessments provide an effective means to communicate the results of Federal research to the policy community.

The allocation of Federal research funding among the air quality issues is shown below.

**Federal Air Quality Research Funding by Issue  
(\$Millions)**



\* President's budget

What follows is a brief description of research underway and planned to address key information gaps in each of the areas listed above.

## AGENCY RESEARCH EMPHASES

### Particulate Matter and Visibility



#### Synopsis:

Fine particle research is an area of increasing emphasis, driven by a growing body of evidence linking fine particle exposure to significant adverse health effects and concern for deteriorating visibility in the most pristine areas of the country. Several major multi-agency field campaigns and intensive measurement programs are planned with significant participation by the private sector (university and industry researchers) to provide the observations needed to support health studies, better understand the underlying science, and evaluate predictive models. Our ability to advance the science in this area is impeded by the limitations of current measurement technology. Therefore, a special effort is being made to improve our ability to properly characterize fine particles and their precursors.

#### Budgets:

| Agency/Department                               | Funding (\$ millions) |             |             |         |
|---|-----------------------|-------------|-------------|---------|
|   | 1998                  | 1999        | 2000*       | >2000** |
| Department of Agriculture                       | 3.7                   | 6.5         | 7.5         | ↑       |
| Department of Energy                            | 6.8                   | 6.0         | 6.7         | ↑       |
| Department of the Interior                      | 2.0                   | 2.0         | 2.0         | ↔       |
| Environmental Protection Agency                 | 55.4                  | 55.7        | 61.9        | ↔       |
| National Oceanic and Atmospheric Administration | 0.2                   | 0.8         | 1.0         | ↑       |
| Tennessee Valley Authority***                   | 0.3                   | 0.5         | 0.6         | ↔       |
| <b>Total</b>                                    | <b>68.4</b>           | <b>71.5</b> | <b>79.7</b> |         |

\*President's budget \*\* arrows indicate expected funding trends \*\*\* Non-appropriated

#### Within the Federal sector, the research focus of individual agencies/departments is:

##### Department of Agriculture:

Several of the US Department of Agriculture agencies are involved in fine particle research.

The Agricultural Research Service conducts programs to determine the impact of wind erosion and pesticide/herbicide applications on ambient levels of PM<sub>10</sub> and PM<sub>2.5</sub>.

The Cooperative State Research, Education, and Extension Service supports research on agriculture-related emissions of PM<sub>10</sub> and PM<sub>2.5</sub> and their precursors (e.g., ammonia).

The US Forest Service is working to understand the particle formation processes and to quantify fine particle and precursor emissions associated with prescribed burns and wildfires.

Department of Energy:

**FY98** - The DOE Office of Science conducted the Mexico City Air Quality Study as part of its Environmental Meteorology Program. This study investigated aerosol formation and transport under highly polluted conditions. The Office of Science also conducted a field campaign in the Phoenix area during the summer of 1998 as part of the Atmospheric Chemistry Program. This effort involved both PM issues and ozone issues.

**FY99** – The DOE Office of Science will conduct field campaigns in Nashville and Philadelphia, in conjunction with other agencies, to better understand conditions leading to high concentrations of fine particles.

**FY00** - The DOE Office of Science will conduct a field measurement campaign in East Texas, as part of its Atmospheric Chemistry Program, to quantify fine particle formation under conditions of high humidity and abundant man-made hydrocarbons in the presence of marine aerosols. The Office of Science will also conduct a field campaign as part of its Environmental Meteorology program, probably in the Salt Lake City area, focusing on vertical transport and mixing.

**FY01** – The DOE Office of Science is developing a new Tropospheric Aerosol Program which will focus on the life cycle of aerosols, i.e., the processes governing the loading, composition, and microphysical properties of aerosols.

Department of the Interior: (National Park Service & US Fish and Wildlife)

1. Continue monitoring in National Parks, Wilderness Areas, and other public lands.
2. Research aimed at understanding aerosol effects on visibility.
3. Research on predicting the transport and chemical transformation of visibility-affecting air pollutants and fine particles.
4. In 1999, in partnership with EPA, establish 108 new visibility-monitoring systems in the Interagency Monitoring of Protected Visual Environments (IMPROVE) network (68 upgrades and 30 new sites).

Environmental Protection Agency

**FY99-FY00** - Research conforming to the portfolio proposed by the National Academy of Sciences committee. Heavy emphasis on health and exposure in preparation for the National Ambient Air Quality Standards (NAAQS) review. The fraction dedicated to compliance will gradually increase as we move toward implementation of the NAAQS. A significant portion of the funding is going to grants, centers and interagency cooperatives. While not included as research resources in the budget table above, EPA's Office of Air and Radiation will be setting up and maintaining a multi-tiered particulate matter monitoring network which includes; nation-wide monitoring of fine particle mass, visibility and haze monitoring (see IMPROVE above), special speciation monitoring at 200-300 locations, and intensive "super-site" monitoring employing state-of-science

measurements at 4-7 locations. The information from this network is of utmost importance to all research in this area.

**FY01** - Anticipate an increase in effects and exposure research oriented to causal agents. There will also be an increased emphasis on research dedicated to implementation of the NAAQS.

National Oceanic and Atmospheric Administration:

**FY98-99** - Basic laboratory studies of aerosol nucleation processes. Development and evaluation of instrumentation to quantify aerosol composition (single particle mass spectrometer) and precursor (ammonia, nitric acid) concentration. Conduct field campaigns with colleagues from the Southern Oxidants Study (EPA, DOE, TVA, universities, industry, and States) in Nashville and Atlanta to improve understanding of the key processes and provide the observations to test the predictive capability of models.

**FY00 and beyond** - Laboratory studies of chemical reactions on aerosol surfaces. Instrument development focused on semi-continuous methods for aerosol composition measurements. Field campaign with SOS colleagues in East Texas to quantify fine particle formation under conditions of high humidity and abundant man-made hydrocarbons in the presence of marine aerosols.

Tennessee Valley Authority:

**FY98** - In conjunction with NPS, DOE and EPRI, study impacts on visibility in Great Smoky Mountains National Park (GSMNP). Determine source contributions to fine PM levels in region (mobile sources, semi-volatile components, other source apportionment); Conduct study of fine particle formation in coal-fired power plant plumes.

**FY99** - Continuation of FY98 work; improvement of future regulatory models for assessing regional particle formation. Participate in SOS field campaign in Nashville, focus

on fine particle formation in power plant plumes. Initiate fine particle measurements at second site (Cove Mountain) near GSMNP. Participate in Southern Appalachian Mountain Initiative (SAMI) modeling and integrated assessment (includes ozone, acid deposition and visibility).

**FY00 (proposed)** - Continuation of modeling to evaluate PM formation; continue visibility impacts in GSMNP; Operation of PM<sub>2.5</sub> Supersite at Cove Mountain.; Complete field study results, Complete PM source apportionment analyses.

**Contributing Research:**

National Aeronautics and Space Administration:

NASA carries out research in several areas relative to the distribution of aerosols in the atmosphere and the processes that control aerosol composition. NASA's aerosol research

helps provide a scientific and geophysical perspective for the more focused interest in atmospheric particulate matter carried out by other agencies. Particular elements of the NASA program include:

1. laboratory and model studies of processes by which aerosol particles form in the atmosphere and the relationship between chemical and physical properties of particles and the conditions under which they form
2. in situ measurements of particle properties and those of precursor species, typically made through airborne platforms that fly in the upper troposphere and lower stratosphere
3. remotely-sensed measurements of aerosol presence, providing some information on properties such as concentration, size distribution, optical depth. For particulate matter studies, column measurements of aerosol presence over land are probably of greatest interest. These measurements are made by the Total Ozone Mapping Spectrometer (TOMS) instrument, and additional measurements may be made by the Moderate Resolution Imaging Spectroradiometer (MODIS) to fly aboard the Terra Platform of the Earth Observing System scheduled for launch in the summer of 1999.

National Institute of Environmental Health Sciences:

The NIEHS, as a component of the National Institutes of Health, is a basic biomedical research organization. The results of research, performed by grantees at universities across the U.S. and in the institute's intramural laboratories, is used by policy makers and regulatory agencies to set standards for the protection of the environment and public health. In the case of PM, the studies seek to expand the knowledge base of how particulate matter exhibits adverse reactions on the functioning of lung tissues and cells, and thus will provide information needed to make sound environmental policy. Areas of research focus includes:

1. Mechanisms of particle-induced pulmonary injury.
2. Associations between ambient air pollution and cardiovascular morbidity.
3. Role of exposure to environmental pollution (including indoor allergens) and asthma morbidity.
4. Assessment of personal exposure to ambient particles

National Science Foundation:

The National Science Foundation supports research on atmospheric aerosols through a variety of programs within the Division of Atmospheric Sciences. This work is aimed at understanding the physical, chemical, and optical properties of aerosols, their global distribution and impact on the Earth's radiative budget, as well as aerosol formation, processing, and removal mechanisms. NSF supported work includes field measurements, instrument development, modeling, and laboratory studies.

**Subcommittee Focus Areas:**

State-of-science PM assessment: The Subcommittee will work through NARSTO to initiate a state-of-science assessment that will provide a single source of policy-relevant scientific information on atmospheric fine particles, their sources, morphology, and



distribution. The information gathered from the international scientific community will provide the basis for formulation of effective policies.

Outreach to the health research community: Efforts, over the past two years, to develop programs for fine particle research have highlighted the need for a closer interaction among the atmospheric sciences, exposure and health effects research communities. The Subcommittee will build on the collaborations that have emerged from the PM planning process to strengthen its ties with health research related to air quality, both in the Federal and private sectors. Such collaboration is essential if we are to are to craft effective management strategies in the face of uncertainty regarding the agent(s) responsible for the adverse health impacts.

## OZONE AND ASSOCIATED AIR POLLUTANTS



### Synopsis:

Development of an improved predictive capability for elevated concentrations of ground-level ozone has been a major priority for the Subcommittee. The clearer picture that is developing is presented in the NARSTO state-of-science assessment scheduled for release in 1999. Current and proposed research is focused on gaining a better understanding of the factors that influence the efficiency of the chemical processes leading to the formation of ozone and a host of other pollutants such as fine particles and acids. Several multi-agency field campaigns are planned in conjunction with the private sector (university and industry researchers) to address key information gaps. The measurements planned will provide new insights into both ozone and fine particle formation. Plans also call for an increased emphasis on atmospheric mixing and transport, including nighttime phenomena.

### Budgets:

| Agency/Department                               | Funding (\$ millions) |             |             |         |
|---|-----------------------|-------------|-------------|---------|
|   | 1998                  | 1999        | 2000*       | >2000** |
| Department of Agriculture                       | 0.1                   | 1.2         | 1.5         | ↔       |
| Department of Energy                            | 3.8                   | 3.8         | 3.8         | ↔       |
| Department of the Interior                      | 1.5                   | 1.9         | 1.6         | ↔       |
| Environmental Protection Agency                 | 18.3                  | 20.1        | 7.2         | ⇒       |
| National Oceanic and Atmospheric Administration | 3.8                   | 3.3         | 3.3         | ↔       |
| National Science Foundation                     | 2.1                   | 2.1         | 2.1         | ↔       |
| Tennessee Valley Authority***                   | 0.2                   | 0.2         | 0.1         | ↓       |
| <b>Total</b>                                    | <b>29.8</b>           | <b>32.6</b> | <b>19.6</b> |         |

\*President's budget \*\* arrows indicate expected funding trends \*\*\* Non-appropriated

### Within the Federal sector, the research focus of individual agencies/departments is:

#### Department of Agriculture:

The USDA's ozone research program is focussed on developing a better understanding of the impact of rural ozone, in combination with other stressors, on the yields of economically-important crops throughout the country.

#### Department of Energy:

**FY98** – The DOE Office of Science, as part of its Atmospheric Chemistry Program and in conjunction with the Arizona Department of Environmental Quality, conducted a field campaign in the Phoenix basin to examine the effects of a dry, natural hydrocarbon poor

environment on ozone formation rates and efficiencies and to characterize the effects of terrain-induced circulation of ozone in the region.

**FY99** – The DOE Office of Science will conduct field campaigns in Nashville and Philadelphia, in conjunction with other agencies, to examine chemical and meteorological factors that control ozone formation and distribution in these two very different cities.

**FY99-00** – The DOE Office of Science is sponsoring a variety of research efforts in its Atmospheric Chemistry Program, including both laboratory and field measurements, and modeling, to improve our understanding of the chemical and physical processes affecting energy related air pollutants such as sulfur and nitrogen oxides, tropospheric ozone, etc., including gas-to-particle conversion processes.

**FY99-00** – The DOE Office of Science is sponsoring a variety of research efforts in its Environmental Meteorology Program to improve understanding of the meteorological processes that control the dispersion of energy-related chemicals and particulates in or released to the atmosphere.

Department of the Interior: (National Park Service)

1. Continued monitoring in National parks to determine trends and baseline conditions.
2. Research on understanding the effects of ozone on natural ecosystems.
3. Research on defining the sources of rural ozone.

Environmental Protection Agency:

**FY99-00** - Focus on completing Phase I (first 5 years) of the NARSTO agenda, i.e., delivering critical models, methods, and process understanding for State Implementation Planning and progress tracking. The 1999 NARSTO Assessment is expected to highlight future research needs; to be addressed in context of PM and co-pollutants. Emerging health and exposure needs will also be addressed in context of PM research. The FY99 budget contains an earmark for the development of a smog chamber facility for volatile organic compound (VOC) reactivity studies at the University of California at Riverside. While not accounted for as research resources in the budget table above, EPA's Office of Air and Radiation will continue to maintain its specialized Photochemical Air Monitoring Station network installed during the early 1990's to provide status and trends information on key ozone precursors. This information is of utmost importance to all research in this area.

**FY01** - Funding at a reduced level with emphasis on maintaining a critical mass of core capability for modeling, measurements, emissions, and assessments.

National Oceanic and Atmospheric Administration:

**FY98-99** - Laboratory studies on the role of aldehyde chemistry in ozone formation. Development of improved instrumentation for the quantification of volatile organic compounds (VOCs). Conduct field campaigns with colleagues from the Southern Oxidants Study (EPA, DOE, TVA, universities, industry States) in Nashville and Atlanta to improve our understanding of the key processes and provide the observations to test

the predictive capability of models. Operate North American ozonesonde network to document trends in ozone aloft.

***FY00 and beyond*** - In conjunction with SOS colleagues, conduct field campaign to study ozone formation in East Texas, a region that has recorded the second highest ozone concentrations in the U.S. In this region, reactive hydrocarbons are dominated by man-made sources providing an important contrast to similar studies conducted in the Southeast, where naturally-produced hydrocarbons dominate. Instrument development will focus on the fast-response detection of aromatics. Continue operation of ozonesonde network.

National Science Foundation:

NSF supports basic research that contributes to a fundamental understanding of the processes governing tropospheric ozone formation. This includes laboratory studies, field measurements, instrument development and modeling.

***FY98 and 99*** - Among the major activities supported by NSF was PROPHET (Program for Research on Oxidants: PHotochemistry, Emissions, and Transport), a NARSTO project focused on rural ozone chemistry.

Tennessee Valley Authority:

***FY98*** - Evaluation of combined O<sub>3</sub>/PM modeling tools using air quality data from intensive field campaigns. Participate in Southern Appalachian Mountain Initiative (SAMI) modeling and integrated assessment (includes ozone, acid deposition and visibility).

***FY99*** - Continue SAMI integrated assessment activities.

***FY00*** - Continue SAMI integrated assessment activities; perform modeling for SAMI assessment.

**Contributing Research:**

National Aeronautics and Space Administration:

NASA carries out research in several areas relative to the distribution of ozone and other trace gases in the global troposphere, and the processes that control tropospheric ozone concentrations. NASA's tropospheric chemistry research helps provide a scientific and geophysical perspective for the more focused interest in tropospheric chemistry and air pollution carried out by other agencies. Particular elements of the NASA program include:

1. laboratory studies of the chemical processes important in the chemistry of the global troposphere, including both gas phase and heterogeneous chemical processes
2. in situ and remotely sensed measurements of concentrations of ozone and related trace gases in the troposphere and stratosphere typically made through airborne

platforms. Development of new instrument technology suitable for use on airborne platforms is also carried out.

3. Development of large regional scale and global models simulating the trace constituent composition of the global troposphere and the role which chemical, microphysical, and meteorological processes play in controlling ozone concentrations
4. Remotely-sensed measurements of concentrations of ozone and related trace gases in the atmosphere. For air pollution studies, measurements of tropospheric ozone (column-integrated) made by the Total Ozone Mapping Spectrometer are probably of greatest interest. Tropospheric applications of data from the European Global Ozone Monitoring Experiment (GOME) are also being developed, and these may be of interest. New measurements of the vertical distribution of carbon monoxide in the troposphere (and total column methane) will become available from the Measurement of Pollution in the Tropics (MOPITT) instrument to fly aboard the Terra Platform of the Earth Observing System scheduled for launch in the summer of 1999.

### **Subcommittee Focus Areas:**

Air quality changes associated with proposed NO<sub>x</sub> reductions: The EPA NO<sub>x</sub> rule that was finalized in 1998 is intended to reduce regional transport of ozone in the eastern United States while producing the largest NO<sub>x</sub> reduction in history. These changes are, in turn, expected to affect profoundly the concentration, distribution, and deposition rates of a wide variety of air pollutants. Key questions include how much emission reduction will we actually get? How much corresponding improvement will there be in the atmosphere? And how much of a reduction will there be in human health and ecological effects of air pollution? This is an unprecedented opportunity to document the benefits of emission controls while improving scientific understanding and predictive capability. Although there is substantial monitoring and research capability already in place, significant gaps will limit our ability to assess what works and why. Thus, the Subcommittee is taking steps to ensure that these gaps are filled and that a diagnostic measurement program is in place.

Ozone state-of-science assessment: The completion of the NARSTO ozone assessment is a high priority for the Subcommittee. The results of this effort are expected to shape policy and identify future research directions.

## ACIDIC DEPOSITION



### Synopsis:

With the passing of the acid deposition provisions of the 1990 Clean Air Act Amendments, the mission of the National Acid Precipitation Assessment Program changed to one of continued monitoring of emissions to acidic deposition to effects and evaluating the effectiveness of Title IV. Concomitantly, demand for acidic deposition research has decreased and annual funding for research and monitoring has decreased to about \$4M. Approximately two-thirds of this is spent on long-term monitoring of precipitation chemistry, which is necessary to detect and quantify changes in deposition rates resulting from emissions control programs. The remaining funds are used to improve atmospheric chemistry models and the measurement and spatial distribution of dry deposition.

### Budgets:

| Agency/Department                               | Funding (\$ millions) |            |            |         |
|---|-----------------------|------------|------------|---------|
|   | 1998                  | 1999       | 2000*      | >2000** |
| Department of Agriculture                       | 0.1                   | 0.1        | 0.1        | ↔       |
| Department of the Interior                      | 1.9                   | 1.9        | 1.8        | ↔       |
| National Oceanic and Atmospheric Administration | 0.8                   | 0.8        | 0.8        | ↔       |
| National Science Foundation                     | 0.9                   | 0.9        | 0.9        | ↔       |
| <b>Total</b>                                    | <b>3.7</b>            | <b>3.7</b> | <b>3.6</b> |         |

\*President's budget \*\* arrows indicate expected funding trends

### Within the Federal sector, the research focus of individual agencies/departments is:

#### Department of Agriculture:

The U.S. Forest Service continues to monitor acidic deposition through collaboration with other Federal agencies and the private sector in the National Atmospheric Deposition Program/National Trends Network (NADP/NTN).

#### Department of the Interior: (U.S. Geological Survey, National Parks Service, US Fish and Wildlife)

1. Continue monitoring acidic deposition via the NADP/NTN (DOI supports over 100 of the 220 sites)
2. Conduct assessment of the response in deposition and stream chemistry to Title IV SO<sub>2</sub> reductions.
3. Research on the role of acidic deposition in soil calcium depletion and consequences for forest productivity.
4. Research on the contribution of atmospheric nitrogen deposition to total N loading to sensitive aquatic and terrestrial ecosystems.

National Oceanic and Atmospheric Administration:

Continued operation of the Atmospheric Integrated Research Monitoring Network (AIRMoN). Data examined for trends in rural air quality and dry and wet deposition of acidic substances in relation to changes in precursor (sulfur dioxide, oxides of nitrogen, and ammonia) emissions.

National Science Foundation:

NSF supports basic research in several areas which contribute to our understanding of factors controlling the distribution and deposition of atmospheric acids. These areas include laboratory, field, and modeling studies of tropospheric oxidant chemistry, heterogeneous processes, aerosol/precipitation chemistry, vertical transport/precipitation scavenging, and depositional processes.

**Contributing Research:**Environmental Protection Agency:

The Clean Air Status and Trends Network (CASTNet) operates 68 sites nationwide that provide valuable information on ambient concentrations and dry deposition of acidic air pollutants and their relation to changing emissions. EPA is using large-scale air quality models to estimate the effects of proposed emission changes on the distribution and quantity of acidic deposition. EPA's core ecosystem research program with its focus on watershed process, characterization, and stress/response relationships will continue to contribute insights on impacts due to changes in acidic deposition.

**Subcommittee Focus Areas:**

Document changes in air quality and acidic deposition resulting from emission reduction programs: As the emissions of acid precursors are reduced, it is critical that a comprehensive observing system be maintained to determine if the expected environmental responses are indeed occurring and to identify any confounding factors. The Subcommittee will work to preserve the primary observing systems used to monitor regional air quality and acidic deposition - NADP/NTN, AIRMoN, and the CASTNet. The connections between changes in emissions and changes in regional air quality and deposition will be presented in the National Acid Precipitation Assessment Program's periodic reports to Congress.

## HAZARDOUS AIR POLLUTANTS



### Synopsis:

Hazardous air pollutants or “air toxics” is an area of growing concern and emphasis. Work is proceeding on the development and evaluation of new approaches to the assessment of air toxic exposure, including improved monitoring and modeling approaches and protocols. Efforts are also underway to identify those ecosystems most sensitive to toxics exposure and deposition. New risk analysis approaches are also under development

### Budgets:

| Agency/Department               | Funding (\$ millions) |             |             |         |
|---------------------------------|-----------------------|-------------|-------------|---------|
|                                 | 1998                  | 1999        | 2000*       | >2000** |
| Department of the Interior      | 0.0                   | 0.5         | 0.0         | ↔       |
| Environmental Protection Agency | 17.8                  | 19.7        | 20.6        | ↑       |
| Tennessee Valley Authority***   | 0                     | 0           | 0.1         | ↑       |
| <b>Total</b>                    | <b>17.8</b>           | <b>20.2</b> | <b>20.7</b> |         |

\*President's budget \*\* arrows indicate expected funding trends \*\*\* Non-appropriated

### Within the Federal sector, the research focus of individual agencies/departments is:

#### Department of the Interior: (U.S. Geological Survey)

**FY99** - Initiate national assessment of selected aquatic ecosystems susceptible to contamination from mercury through atmospheric sources. Provide scientific information to support regulatory and policy decisions related to air quality standards and practices, fish consumption advisories, land management practices, and wildlife protection programs.

**FY00** - Assessment postponed.

#### Environmental Protection Agency:

**FY99-00** - A risk-based dimension will be added to what is currently a technology-based program. A strategic plan and a program plan for air toxics research will be developed. The FY99 budget contains earmarks for centers on air toxics metals and urban toxics.

**FY01** - Research initiative will have growing attention given to human exposure measurements and modeling, human health risk including cancer and non-cancer effects, dose/response, and risk assessment, atmospheric chemical and meteorological processes effecting transport and fate, source characterization, and control approaches



Tennessee Valley Authority:

Perform ambient measurements of selected toxic air pollutants in region and compare to modeled estimates of emissions from potential sources.

**Contributing Research:**Environmental Protection Agency:

EPA's core human health effects and ecosystem research programs will contribute information and insights to an array of hazardous air pollutant and human and ecosystem health issues, including those addressing persistent bio-accumulating toxics, e.g. persistent organic pollutants, endocrine disruptors, and neurotoxins such as mercury, with their sources, transport, transformation and fate.

**Subcommittee Focus Areas:**

Air Toxics Research Strategy: The Subcommittee will hold a series a meetings with special attention being paid to hazardous air pollutants and their environmental and human health risks. The Subcommittee will establish a set of priority science questions and corresponding research needs to identify and address important risks. We will prepare an inventory of focused and contributing research and identify crucial gaps between that ongoing and that needed. Federal agencies with appropriate capabilities and capacity will coordinate their activities to address needed research and fill gaps. These actions will form the basis of a federal research strategy on hazardous air pollutants.

The subcommittee will build on its experience collaborating with the exposure and health research communities on the particulate matter issue. Subjects likely to be addressed in the strategy include: source characterization, atmospheric chemical and meteorological processes, human exposure, human health risk, dose/response relationships, risk assessment; and risk management.

## INDOOR AIR QUALITY



### Synopsis:

A better understanding of the indoor environment has taken on increased importance with the realization that most people spend approximately 90% of their time indoors. In addition, for many pollutants, concentrations are higher indoors than outdoors. Characterization of the pollutants found indoors and their health risks is underway at several federal agencies. Mitigation methods and techniques for controlling exposure to indoor pollutants are also a significant research foci. However much of the federal research on indoor environments is integrated into other programs so that no separate funding is identified, e.g., at EPA, most indoor air research is subsumed under PM and Air Toxics research programs.

### Budgets:

| Agency/Department               | Funding (\$ millions) |            |            |       |
|---------------------------------|-----------------------|------------|------------|-------|
|                                 | 1998                  | 1999       | 2000*      | >2000 |
| Environmental Protection Agency | 2.1                   | 2.8        | 0.0        | ↔     |
| <b>Total</b>                    | <b>2.1</b>            | <b>2.8</b> | <b>0.0</b> |       |

\*See contributing research below

### Within the Federal sector, the research focus of individual agencies/departments is:

#### Environmental Protection Agency:

The FY 98 and FY99 Indoor Air Research Program line item was focused on understanding the health effects of indoor air pollutants. In FY00 asthma research, previously conducted under this program is to be redirected to the Agency's Children Health Risk Research Program.

### Contributing Research:

#### Environmental Protection Agency:

EPA is conducting Indoor air research as part of other programs:

- PM and air toxics programs on source emissions and source management that are examining the relationship between PM indoor and outdoor concentrations and exposures,
- the development of methods and models that can be used to quantify source emissions (both gases and particles), and the identification of prevention approaches to manage these source emissions,
- field studies of multimedia pollutants in indoor environments, and
- studies focused on respiratory issues such as the relationship between indoor contaminants and pediatric asthma.

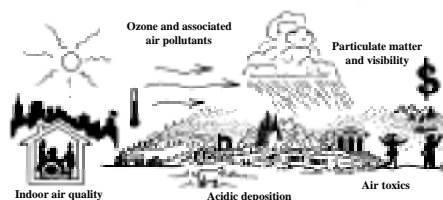
Housing and Urban Development:

HUD is conducting studies on lead dust and blood lead levels as well as mitigation and control of lead exposure.

National Institute of Environmental Health Sciences:

NIEHS is examining mechanisms of response to allergens, and exposure and control of allergens, including cockroach and dust mites.

## ONE ATMOSPHERE



### Synopsis:

There is an increasing awareness that many atmospheric processes and species are common to multiple issues. Processes that control atmospheric mixing and transport are an obvious example. Much of the chemistry that produces ozone also generates fine particles and acids. Changes in VOC and NO<sub>x</sub> emissions can fundamentally change the oxidative capacity of the atmosphere and profoundly affect the concentration, distribution, and deposition of a variety of air pollutants. Thus, emission reductions targeted at mitigating one pollutant can significantly effect another, either positively or negatively. These research efforts are aimed at identifying opportunities for coordinated approaches to air quality management and avoiding instances where, efforts to improve one problem exacerbate another.

### Budgets:

| Agency/Department                               | Funding (\$ millions) |            |            |         |
|---|-----------------------|------------|------------|---------|
|   | 1998                  | 1999       | 2000*      | >2000** |
| Environmental Protection Agency                 | 1.3                   | 3.9        | 0.0        | ↔       |
| National Oceanic and Atmospheric Administration |                       | 0.5        | 0.7        | ↑       |
| <b>Total</b>                                    | <b>1.3</b>            | <b>4.4</b> | <b>0.7</b> |         |

\*President's budget \*\* arrows indicate expected funding trends

### Within the Federal sector, the research focus of individual agencies/departments is:

#### Environmental protection Agency:

Program subsumed within co-pollutant portions of PM, tropospheric ozone, and air toxics programs.

#### National Oceanic and Atmospheric Administration:

Laboratory and field studies conducted to investigate linkages between gas-phase chemistry responsible for ozone formation and the formation of semi-volatile material that is subsequently incorporated into fine particles.

### Contributing Research:

#### Department of Energy:

The DOE Office of Science Atmospheric Sciences Program as a whole could be considered to fit under the "One Atmosphere" category, however much of the research fits directly under PM research and under ozone research. The overall program is organized into several elements and there is a great deal of synergism between these – the Atmospheric Chemistry Program, the Environmental Meteorology Program, the

Tropospheric Aerosol Program, and the Research Aircraft Facility. Most field measurements campaigns have multiple or inter-related objectives and there is a substantial interaction between the various science teams.

National Aeronautics and Space Administration:

NASA's research in atmospheric chemistry is designed to provide useful information that may cut across the different issues associated with atmospheric chemistry. In particular, global models that simulate the troposphere and stratosphere, as well as satellite data sets that provide useful information on both regions of the atmosphere, can help address questions like ozone depletion, global climate change, and global air pollution at the same time. Laboratory research on fundamental chemical and microphysical processes can have applications to multiple issues, as can *in situ* and remote sensing technology development.

**Subcommittee Focus Areas:**

Connections among issues: The Subcommittee will look at ways to integrate research results, providing a "heads-up" for the policy makers on how emission reductions targeted for one issue may beneficially or adversely affect another. The Subcommittee will also explore connections between air quality and climate through a series of joint programs with the Global Change Research Subcommittee of the CENR. The result will be integrated programs designed to understand how changes in future climate may affect efforts to mediate exposure to harmful air pollutants.

Air quality monitoring networks: The Nation's air quality monitoring networks are an invaluable asset providing an indication of population exposure, information on linkages between sources and receptors, and an evaluation of the effectiveness of air quality management strategies. The Subcommittee is working to preserve and enhance these networks through better, less costly designs; the promotion of improved data accessibility; and leveraged investments through the deployment of multi-purpose monitors. An important first step in this process is the development of an inventory of air quality monitoring networks. This effort was begun in 1998 and will culminate with the publication of a report on the Nation's air quality monitoring networks in 1999.

## AGENCY AIR QUALITY RESEARCH PROGRAMS

Each of the agencies and departments that make up the Air Quality Research Subcommittee of the CENR bring a unique perspective to the issues being addressed. It is that perspective, born out of each agency's mission and priorities, and the complimentary nature of the capabilities of the scientists and resources in the individual programs that is the strength of the integrated program crafted by the Subcommittee.

A brief description of each agency's air quality research focus is provided below.

### **Department of Agriculture (USDA)**

The USDA air quality research and monitoring program involves studies on the occurrence of particulate matter (PM) arising from farming and associated operations, including cooperation with experts working on human health effects of PM.. In addition, the Department cooperates in the Federal multi-agency and university atmospheric deposition monitoring and research support project known as National Acid Deposition Program/National Trends Network (NADP/NTN). This project is evolving from focus solely on acidic deposition to include detection of nitrogen compounds, base cations, and other chemicals from the standpoint of soil nutrient status and eutrophication of estuarine and freshwater systems. New monitoring network effort now includes detection of mercury in precipitation. The Department also collaborates with other agencies and universities in extramural programs aimed at monitoring of tropospheric ozone, and its impacts on crop productivity.

The USDA has established networks with universities, government and industry for jointly conducting research, transferring new technologies, disseminating information, and monitoring the environment with the aid of our extensive agricultural and forestry research and extension system, as well as the non-research efforts of the National Forest System, Natural Resource Conservation Service, Consolidated Farm Service Agency, and the National Agricultural Library.

### **Department of Energy (DOE)**

The goal of the DOE Atmospheric Science Program is to develop a comprehensive understanding of the atmospheric processes that control the transport, transformation, and fate of energy related chemicals and particulate matter. The drivers for the program include regional, national, and global concerns for air quality, climate change (global warming), and related energy policy.

The objectives of the program are (1) to improve our understanding of the chemical and physical processes affecting energy related air pollutants such as sulfur and nitrogen

oxides, tropospheric ozone, etc., including gas-to-particle conversion processes, and the deposition and resuspension of associated aerosols; (2) to improve understanding of the meteorological processes that control the dispersion of energy-related chemicals and particulates in or released to the atmosphere; and (3) to develop predictive models for the above processes and acquire the data to validate them.

The overall Atmospheric Science Program consists of several closely-related science programs and facilities. Each program includes scientist-participants from DOE laboratories, other federal laboratories, colleges and universities, and private industry. All projects are fully-peer reviewed.

The Atmospheric Chemistry Program (ACP) focuses on chemical transformations relating to tropospheric energy-related materials, including a) regional, continental, and global scale research on energy related air pollutants, b) aerosol influences on air quality and climate forcing, c) modeling and characterization of fine particles in the atmosphere. Activities include field measurement campaigns, laboratory studies, and modeling.

The Environmental Meteorology Program (EMP) focuses on the transport of energy-related materials through the atmosphere through specific and timely program components. Previous components include the Atmospheric Studies of COMplex Terrain (ASCOT) and the Mexico City Air Quality Study (MCAQS). Current components are the Atmospheric Boundary Layer Experiment (ABLE) and the Vertical Transport and Mixing Program (VTMX).

### **Department of Health and Human Services (HHS)**

The National Institute of Environmental Health Sciences (NIEHS) supports research related to the health impacts of indoor and outdoor air pollutants such as acid aerosols, particulate material, ozone, radon, and air toxics. The focus is on identifying harmful agents, determining mechanisms by which they produce effects, and developing and evaluating the impact of prevention and intervention strategies.

### **Department of the Interior (DOI)**

DOI air quality research includes the collection of data and information on air quality conditions and trends in national parks and wilderness areas, effects of air pollution on resources, the pollutants responsible for resource damage, sources of pollutants, and the effect of reducing emissions at these sources. Present monitoring and research programs are focused on acid deposition, ozone, and fine particles as they affect visibility including understanding and predicting the transport and chemical transformation of air pollutants. Assessments of the effects of air quality and atmospheric deposition on sensitive aquatic and terrestrial ecosystems are an integral part of DOI's air quality monitoring research strategy.

**Environmental Protection Agency (EPA)**

EPA's air quality research incorporates both core research and problem-driven research in addressing pollutant specific issues identified through the National Ambient Air Quality Standard (NAAQS) setting and implementation process laid out in the Clean Air Act (CAA). The dominant issues now driving EPA's research are those associated with particulate matter and tropospheric ozone. Science to support the multi-decade schedule of NAAQS attainment and periodic (5-year) reviews of the basis of the standards will continue to challenge the limits of scientific understanding for the foreseeable future. Air toxics adds another area of emphasis; the CAA prescribes a source identification, control and residual risk assessment process which relies on the future development of information and technology not now readily available.

In addressing these issues, EPA internally conducts and supports exploratory research through grants according to four classifications of research: 1) human and ecological effects research, including that on dosimetry and mechanisms, epidemiology, and ecosystems; 2) exposure research, including that on atmospheric chemistry and physics, methods and observational assessments, and modeling; 3) risk management research, including emissions characterization and reduction; and 4) risk assessment research, including NAAQS criteria documentation and methods. Partnerships with private industry, academia and other agencies are an integral part of these research and development programs.

**National Aeronautics and Space Administration (NASA)**

NASA brings to environment and natural resources research the ability to view the earth in its entirety from space. This vantage point has led NASA to focus on the study of the earth as a integrated system, examining physical climate systems, biogeochemical cycles, and the linkages between the two.

NASA's Office of Earth Science employs spacecraft, aircraft, balloons, and selected ground-based observations, often in tandem, to collect data useful in a broad range of regional-to-global scale inquiries. These global-scale investigations are conducted in close collaboration with science and space agencies in Japan, France, Germany, Italy, Great Britain, Brazil, Russia, Australia, and Canada, as well as with international organizations such as the European Space Agency and the United Nations Environment Programme.

**National Oceanic and Atmospheric Administration (NOAA)**

NOAA is responsible for long-term monitoring of the oceans and atmosphere and provides both satellite and *in situ* observations, data, and information necessary to understand the earth system, assess changes to that system, and predict future changes.



NOAA forecasts and predicts the future state of the atmosphere, focusing its air quality research on gaining a fundamental understanding of the atmospheric processes that must be characterized for credible and useful predictions.

NOAA's researchers are focusing, under the agency's "Health of the Atmosphere" program on rural and regional air quality issues including surface-level ozone, fine particles, and acid deposition. NOAA's air quality research includes laboratory studies of fundamental chemical and physical processes, field measurements in a variety of environments (both in a campaign mode and regular observations), and theoretical modeling.

### **National Science Foundation (NSF)**

NSF research on air quality is designed to increase understanding of the causes of degraded air quality and provides information needed to improve remediation. Research includes studies of the chemical and physical processes that control tropospheric ozone concentrations over North America and the northern Atlantic Ocean. These activities are coordinated with NARSTO and include observational studies of tropospheric ozone and its chemical precursors, laboratory investigations of associated chemical kinetics and mechanisms, development of improved analytical instrumentation and sampling strategies, and construction and evaluation of relevant models.

### **Tennessee Valley Authority (TVA)**

The primary objective of TVA's air quality research program is to provide a better understanding of the impacts of air pollutants resulting from power production on regional air quality. The program is focused on issues that are important to the Tennessee Valley region and the Nation. Research results are transferred to the policy/regulatory community where they are employed in the development of effective control strategies.

The research program is intended to improve the understanding of the underlying factors that control the distribution of pollutants in the atmosphere and includes laboratory studies, long-term monitoring, intensive field studies, and model development and application. Research is conducted on ground-level ozone, acid rain, particulate matter, and air toxics.

Research activities are conducted in close collaboration with other Federal agencies, the university community and a variety of stakeholder groups.

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