United States
Environmental Protection
Agency

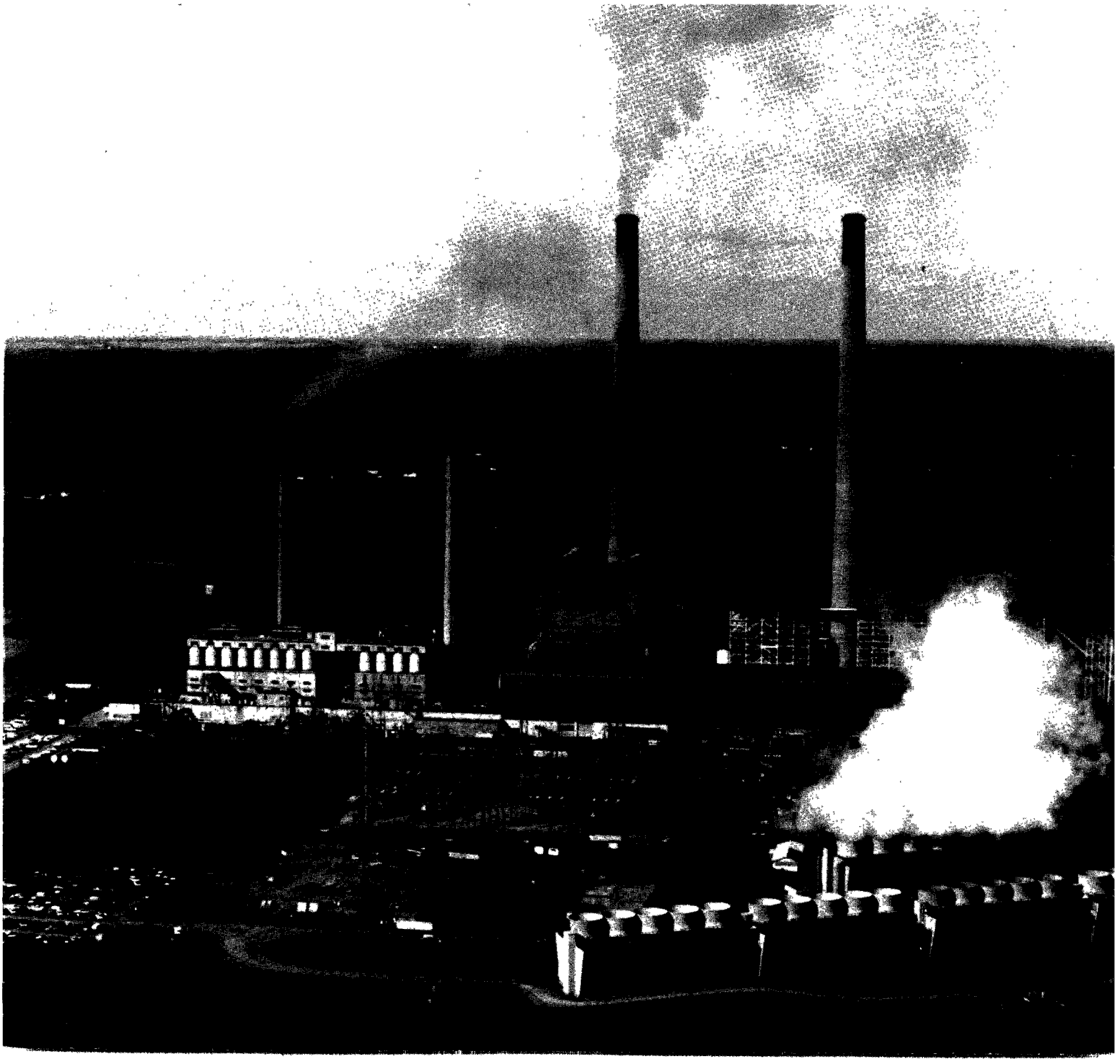
Air and Radiation
(ANR-445)

EPA 400/1-89-001
March 1989

EPA

State Acid Rain Program

Final Report



State Acid Rain Program
Final Report

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ACKNOWLEDGMENTS

Special thanks are due to all who contributed to this report and to the cooperative effort of those participating in the STAR Program. The collective expertise of many individuals extending over a period of several years is represented in this document.

Brian McLean of EPA provided extensive comments and suggested changes that improved this document. Many other reviewers at State air agencies and EPA Regional Offices also contributed constructive comments. Robert Arnott of ERM-Rocky Mountain solicited reactions to the STAR Program from the States and, together with Carol Etter of RCG-Hagler, Bailey, Inc., provided information used in this report. The State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials assisted the production of this report by facilitating a survey of States and their opinions of the STAR Program. John Schakenbach of EPA provided valuable editing assistance.

The contributions of individuals representing the many State air agencies that participated in the STAR Program are acknowledged. These contributions are particularly important in view of on-going regulatory activities which demand the attention of States.

Table of Contents

PREFACE i

EXECUTIVE SUMMARY 1

- BACKGROUND 2
- FUNDAMENTAL DIFFERENCES 2
  - Geographic Scale of Acidic Deposition 3
  - Multistate Operation of the Sources 3
  - Jurisdiction of Control Institutions 3
    - Geographic Scope 3
    - Socio-economic Dimension 4
- PROGRAM TYPES 5
- CONCERNS OF PROGRAM MANAGERS 6
  - Traditional Concerns 6
    - Adequacy of Resources: Financial, Human, and Technical 6
    - Administrative Complexity 6
    - Effect on Existing Air Programs 7
    - Contentiousness of the New Control Program 7
  - New Concerns 8
    - Socio-economic Decision-making 9
    - Involvement of Multiple Agencies 9
    - Multistate Scale 9
- IMPLEMENTATION ISSUES 10
  - State Goals and Design Philosophies 10
  - Adequacy of Resources 10
    - Selection of the Type and Number of Sources 11
    - Data Requirements 11
    - Enforcement 11
  - Multiple Interests / Lead Agency 12
  - Interstate Coordination 12
  - Credible Federal Default 13
  - Timing 13
  - Energy Conservation 13
    - Magnitude of Reductions Achievable 14
    - Relationship of Emissions to Demand 14
    - How States Might Accommodate Conservation in Control Plans 14
  - Control Techniques 15
    - Conventional Controls 15
    - Clean Coal Technologies 16
    - Managed Emissions Dispatch 16
    - Emissions Trading 16
- SUMMARIES OF STAR PROJECTS 17
- USEFULNESS OF THE STAR PROGRAM 17

CHAPTER 1 — INTRODUCTION 19

GEOGRAPHIC SCALE OF ACIDIC DEPOSITION 19
MULTISTATE OPERATION OF THE SOURCES 20
JURISDICTION OF CONTROL INSTITUTIONS 21
Geographic Scope 21
Socio-economic Dimension 22
A NEW RESPONSE 23
THE STATE ACID RAIN (STAR) PROGRAM 23

CHAPTER 2 — IMPLEMENTORS' CONCERNS AND PROGRAM TYPES 27

FOUR BASIC TYPES OF CONTROL PROGRAMS 27
Source-based Control Programs 28
Emission-based Control Programs 28
Pollutant Loadings-based Control Programs 29
Environmental Effects-based Control Programs 30
Increasing Complexity 31
CONCERNS OF PROGRAM IMPLEMENTORS 31
Traditional Concerns 32
Financial Resources 32
Human Resources 32
Technical Resources 32
Administrative Complexity 32
Effect on Existing Programs 33
Contentiousness of a New Control Program 33
New Concerns 35
Socio-economic Decision-making 35
Involvement of Multiple Agencies 35
Interstate Coordination 36

CHAPTER 3 — IMPLEMENTATION ISSUES 37

ISSUES LINKED TO IMPLEMENTORS' CONCERN..... 37
Required Resources and Program Complexity 38
Selection of the Type and Number of Sources 38
Data Requirements 39
Enforcement 41
Interaction with Existing Air Programs 42
Contentiousness of Control Program 43
Equity 43
Flexibility 44
Efficacy 45
Multistate Scale 46
Nature of Utilities 46
Regional Cooperation and Authorities 47
Multiple Interests / Lead Agency 49

ISSUES THAT CROSS PROGRAM LINES 50
State Goals and Design Philosophies 51
Credible Federal Default 51
Timing 52
Energy Conservation 54
Magnitude of Reductions Achievable 54
Relationship of Emissions to Demand 55
How States Might Accommodate Conservation in Control Plans 56
Control Technologies 57
Conventional Controls 57
Clean Coal Technologies 58
Managed Emissions Dispatch 59
Emissions Trading 59

CHAPTER 4 — SUMMARIES OF STAR PROJECTS 63

CHAPTER 5 — USEFULNESS OF THE STAR PROGRAM 71

THE CHALLENGE 71
THE TOOLS 72
THE OPINION OF THE STATES 72
Management Approaches 72
Role of the EPA Regional Offices 73
Role of STAPPA/ALAPCO 73
National STAR Workshops 74
Summary of STAR Management 76

PREFACE

The acid rain issue has been debated for many years by Congress and by numerous interest groups, and has been the focus of intense scientific investigation. The debate centers on the policy question of whether or not there should be a program to control acid rain and how the program should be shaped. Scientific inquiries have been examining research questions regarding the nature and extent of the problem. The State Acid Rain (STAR) Program was designed to address a third question of how to implement a control program should one be enacted, leaving the policy debate and research investigations to others.

Independent of any program to control acid rain, significant national efforts exist to limit emissions of traditional pollutants, including sulfur dioxide, nitrogen oxides and oxidants, which are the principle precursors in the formation of acidic compounds. These efforts are designed to protect public health and welfare by achieving ambient air quality standards. Any effort to control acid rain at the regional scale must be viewed in the context of existing state and local air quality control programs for these pollutants. EPA continues to investigate additional but related long-range transport issues such as visibility and acidic aerosols.

EXECUTIVE SUMMARY

This final report of the STate Acid Rain (STAR) Program documents the results and findings of a four-year, $3 million effort to engage States in identifying and exploring potential issues associated with controlling acidic deposition. In coordination with the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), EPA funded 47 State Projects that focused on management and administrative issues.

The success of the STAR Program may be measured by examining where we are today relative to where we were in 1983 when the program was conceived. By this yardstick, the STAR Program produced definite successes in improving EPA's understanding of State concerns, in improving the States' understanding of EPA's role in carrying out Federal legislation, and in increasing both EPA's and the States' understanding of potential implementation problems. Throughout the course of the Program, the dynamic nature of the issue and the State studies provided a "real-time" relevance to project findings and results. As an overall consequence of the STAR Program, most States are better prepared today than they were in 1983 to carry out a major control program if Congress should decide one is needed. This greater preparedness should lead to better acid rain control planning and more effective implementation. The program also expanded our collective understanding of the management of regional air pollutants in general.

Success of the STAR Program is also evidenced by actions taken independently by several States to explore further many of the issues identified by the STAR Program. In addition, over the past two years, legislative proposals have responded to some of the findings of the Program. The most noticeable response has been the increased time provided States and EPA to prepare plans that reflect the complexities of managing this multistate pollution problem. Finally, EPA is continuing a constructive dialogue with State air agencies and public utility commissions, through their national organizations, on implementation issues associated with the control of acidic deposition.

Chapter 1 provides an overview of fundamental differences between control of acid rain and traditional pollutants. Chapter 1 also details the evolution of a concept for better planning through the design and implementation of the STAR Program.

Chapter 2 describes four general types of acid rain control programs and the concerns that program administrators are likely to have if they were asked to carry them out. The *Program Types* and *Concerns* provide a foundation for Chapter 3, where the nature and significance of potential implementation issues are examined using findings from the STAR Program as supporting evidence. Chapter 4 lists features of the individual State projects and serves as a guide for specific information in each report.

Chapter 5 examines the management of the STAR program and highlights expanded management approaches used by EPA because of the special nonregulatory nature of the effort. Results of a third-party review of the Program (which solicited States' reactions to the program and its management) are presented.

BACKGROUND

By late 1983, EPA became concerned that neither EPA nor the States were well prepared to implement any of the then-current legislative proposals to control acid rain. A concept evolved to work with air pollution program managers because they might be responsible for implementing any future control program. A national network developed of individuals who ultimately might have implementation responsibility. The STAR approach may be contrasted with the traditional state-federal relationship (of implementing mandated control programs) where Federal *operating guidance* is often issued to States without the benefit of first inviting them to analyze the issues and then incorporating their views and perspectives.

Since neither Congress nor the Administration had yet determined that acid rain control legislation was necessary, EPA kept the Program "policy-neutral," by taking no position on the question of whether or not there should be an acid rain control program. Recognizing that participation was voluntary and that other State priorities would compete for time and resources, EPA made special efforts to develop a sense of common purpose among participants. So that all interested parties could benefit from the individual projects, EPA emphasized the importance of clear and concise reporting and designed special management tools to ensure the maximum usefulness of projects by sharing information on issues, options, and results among the States. Finally, the Agency articulated a belief that positive, useful information could be gleaned from failed attempts and unsuccessful investigations, as well as from successful attempts to find workable solutions.

FUNDAMENTAL DIFFERENCES

The existing State and Federal air pollution control programs did not appear appropriate to carry out the solutions being proposed to control acid rain. This mismatch between proposed solutions and the existing infrastructure appeared to be due largely to: 1) the nature of the acid rain problem, in particular, its geographic scale, 2) the multistate operation of the principal sources of acidic deposition, and 3) the jurisdictional limitations of state and local air pollution control agencies.

Geographic Scale of Acidic Deposition

A unique combination of location of coal deposits, industrial development, technology, population, geographic size of states, rainfall patterns, and glacial history create an acidic deposition problem for the thin granitic soils, particularly in the Northeast, Upper Midwest, and Canada, that are downwind of major combusters of high-sulfur coal.

Combustion products (particularly sulfur dioxide and oxides of nitrogen) are emitted, carried by the atmosphere, and transformed with the help of sunlight into sulfates and nitrates and other sulfur-particulate-complexes, which then settle or wash out of the atmosphere. Large-scale atmospheric motion transports the pollution 300 to 500 (or more) miles downwind, thus assuring an interstate problem.

While the greatest extent of damage has occurred on glaciated soils of the Northeast, the thin soils and watersheds of the West are at risk because they have even less capacity to neutralize acids. Also, the soils of the South are currently adsorbing sulfur deposited there, and if the soils become saturated, it is likely that sulfates will pass through to the aquatic systems and acidify them.

Multistate Operation of the Sources

More than two-thirds of total SO_2 emissions (23 million tons in 1985) and about one-third of NO_x emissions (21 million tons in 1985) come from electric utility sources. Due to this and the inherent administrative difficulties and costs of controlling a large number of smaller sources which generally have lower emissions rates (on average), virtually all proposed SO_2 reductions have been directed at electric utilities. Controlling electric utilities for regional benefit requires knowledge of the interstate nature of utility operations.

Electric utilities often serve customers in more than one state, and several large utility holding companies cover multistate regions. Many utilities are also members of one or more power-pools that exchange power among the member utilities. This multistate difference between acid rain and traditional pollutants increases the complexity of regulating interstate sources through existing state-wide institutions.

Jurisdiction of Control Institutions

Geographic Scope

Existing air pollution control programs rely heavily on the action of State and local governments. The primary focus of State control programs since 1970 remains the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS).

These standards are carried forward by the authority provided to each air agency by their respective State legislatures to protect the health and welfare of their residents.

Existing State authorities were designed to resolve in-state pollution problems, not interstate problems. The current Clean Air Act is not well suited to accommodate the large geographic scale of acidic deposition. The Act does not provide sufficient authority to allow one State to require emissions reductions from sources in another State without assistance from EPA. In general, current regulatory practice continues to place the heaviest burden for attainment of ambient standards on the State in which a violation occurs, regardless of the point-of-origin of the emissions which cause the violation. However, occassionally EPA Regional Offices are able to resolve interstate pollution problems.

Use of the existing State air agencies to control sources that typically operate at multistate scales and have out-of-state impacts is generally beyond the jurisdiction and authority of a single State air agency. This situation illustrates a mismatch of problem solution and authority. In the absence of new Federal and State enabling legislation, controlling out-of-state emissions could require regulators to establish either an interstate compact or an interstate agency to determine and enforce specific requirements. Establishing such an interstate agreement or agency would most likely need to be ratified by State legislatures and Congress.

Socio-economic Dimension

Unlike the control of traditional air pollutants where reasonably clear source-receptor relationships and source culpability can be established, allocating emissions burdens for control of acidic deposition would rely less on scientific tools (e.g., diffusion models and ambient measurements), and would rely more on judgments of air agencies and consideration of state-wide social and economic factors. Socio-economic concerns traditionally have been incorporated in developing source-specific standards, but an acid rain control program would shift the balance of these concerns and heighten their importance because of the greater state-wide impact of control decisions (which may affect electricity consumers and the viability of local industries — especially electricity-intensive industries and coal mining).

Fundamental differences between acid rain and traditional pollutants suggested that an institutional response to acid rain control might be fundamentally different as well. Many conventional implementation issues would be complicated further by the interstate nature of the pollution, the multistate extent of the operation of emitters, and the mismatch of scale between pollutants, sources, and the jurisdiction of State regulatory institutions. For these reasons, controlling acid rain would introduce complexities greater than those of controlling traditional pollutants.

PROGRAM TYPES

A goal of all acid rain control proposals is to reduce or eliminate damage from acidic deposition. However, the objectives that control proposals set for the program administrator can be quite different. These objectives affect not only the cost and feasibility of implementation but also the likelihood of achieving the goal.

In the process of investigating implementation issues through the STAR program, a structure emerged that can be used for examining regional pollutants like acid rain and for understanding the nature and significance of potential implementation issues faced by environmental program administrators. This structure may also be useful for examining other environmental control efforts. This taxonomy of control programs as seen from an implementor's perspective consists of four basic types: *source-based, emission-based, pollutant loadings-based*, and *environmental effects-based.*

Source-based control programs are directed at the operation of an emissions source with an emphasis on enforceability of control requirements. Meeting a specific performance standard or emissions rate (in terms of pounds of SO_2/mmBtu of heat input, percent sulfur-in-fuel by weight or by volume, grams of pollutant per mile traveled, for example) provides for a level of performance without directly addressing the choice of hardware required to attain this standard. As long as each source meets its performance standard, the program objective is achieved. An air program manager need not ensure that regional emissions goals or deposition levels are achieved.

Emission-based control programs focus on reducing total emissions over a defined geographic area such as a State, a multistate region, or the entire nation. In an emission-based program, the objective may be stated as an emissions reduction target (typically tons-of-pollutant per year) or as an emissions ceiling. Implementation responsibility is usually assigned to the States for administrative reasons. As long as the total tonnage of emissions is reduced by a specified amount or kept below a specified threshold, the program objective is achieved.

A *pollutant loadings-based* control program's objective is to limit the concentration of a pollutant affecting the environment. The current air program uses National Ambient Air Quality Standards (NAAQS) to protect the health and welfare of the most sensitive individuals and the environment. For acidic deposition, deposition standards could be set to ensure that sensitive resources do not suffer adverse impacts. Setting a deposition standard would not mandate a specific control technology for a source or fix a level of emissions for a region.

The emphasis of an *environmental effects-based* control program is to protect the most sensitive humans, flora, and fauna from the deleterious effects of pollution. Success would be measured by the health and quality of the sensitive resources themselves. Program

objectives for an acid rain program could be expressed in terms of maintaining the diversity and quantity of a fish population or the quality and productivity of a forest. With this program type, regulators have great flexibility in devising strategies so long as the net result is protection of the sensitive resources. However, meeting these biologic standards would add yet another layer of complexity to the job of the program implementor.

CONCERNS OF PROGRAM MANAGERS

Traditional Concerns

A number of traditional concerns are identified as important to managers when new programs are instituted. The primary concerns are:

Adequacy of Resources: Financial, Human, and Technical

When program managers are faced with the prospect of incorporating a new control effort with an existing program, a universal concern is whether the existing capabilities and resource levels can accommodate the new demands; and if they cannot, what additional financial, human, and technical resources will be needed to fulfill the additional responsibilities?

Moving from a source-based approach to an effects-based approach, the amount of financial resources, the skills of the human resources, and the sophistication of technical resources needed to implement a control program all increase substantially.

Administrative Complexity

Administrative complexity of implementation is influenced by the number of decisions that are required to implement a program and the difficulties encountered in making those decisions. Decision-making may be difficult because of lack of (or conflicting) information, uncertainties in the quality and reliability of information, an even balance between the "pros" and "cons" of each option, and lack of clear alternatives. Greater flexibility often leads to greater complexity, greater regulatory responsibility, increased contentiousness, and lengthy litigation — all of which may delay environmental benefit. However, multiple revisions of a simple program can increase administrative complexity, too. In general, programs become more complicated to administer as one moves from the simpler source-based type to the most complex effects-based type, but details of program design and implementation can alter this general rule somewhat.

The administrative complexity of a program is not only a concern of the implementor, but also of the sources and the society at large. A properly conceived and implemented program ensures efficient use of resources and provides for timely achievement of environmental benefits.

Effect on Existing Air Programs

Administrators are concerned that a new air pollution program may conflict or interfere with the operation of existing programs, or at a minimum, may draw resources away from existing programs and hinder their successful administration. Reconciling program goals and activities without creating confusion for the source and/or the enforcement staff is important.

Further control of SO_2 and NO_x would affect existing ambient air programs. States indicated that source- and emission-based programs would be relatively easy to integrate with an existing program but that more complex program types may require establishing a separate program infrastructure within and among States.

Contentiousness of the New Control Program

Implementors wish to minimize the likelihood of conflict, protracted debate, or litigation over a control program because these divert limited resources away from implementation and usually delay achievement of environmental goals. The acceptance of a control program will depend on the perceptions of all affected parties, particularly perceptions of equity, flexibility, and efficacy of the control effort.

Equity. Development of acid rain control plans presents State regulators with a dilemma of how to allocate the costs of control equitably. The more decisions and administrative judgements made by the air agency, the greater the likelihood that concerns of *equity* will dominate and possibly, the more contentious the resulting control program will be.Depending on the type of control program that a manager is asked to implement, administrative and institutional costs can be considerable. Nevertheless, these costs are often overshadowed by the costs of control.

If a source-based program were established by Federal legislation, which applied one *emissions rate* to all existing and new industrial and utility sources, it could be considered equitable even though the costs of complying could vary greatly. In addition, industrial sources could incur both the cost of their own emissions controls and a portion of the electric utility controls through higher rates. Alternatively, assigning emissions reductions solely to utilities shifts costs to ratepayers and may be viewed as subsidizing customers of polluting industries.

In theory, the loadings- and effects-based programs would have a "scientific" equity since controls would be required only from those sources specifically contributing to violations of a deposition standard or causing damaging effects. However, costs of control would also fall only on specific sources. The emission-based program provides the implementor with the most flexibility to allocate the costs of control.

Flexibility. In order to implement a control program smoothly, most implementors desire the flexibility to determine which sources are to be controlled, with consideration of the economic consequences of those controls on a particular company, industry, locale, and State. Further, implementors desire the flexibility to choose among a number of available strategies and to select the most effective reduction strategy for their State.

Under the source-based approach, the role for States is limited to enforcing source performance. Source-specific standards have the benefit of reducing administrative burdens and encouraging rapid implementation and control. An emission-based control program may allow States the option of determining specific control actions to be taken at each source, so long as an overall emissions goal is achieved. Loadings- and effects-based control programs provide regulators with the flexibility to select the most environmentally effective control strategies. Controls are needed only for those sources causing the loadings or effects standard to be exceeded.

Efficacy. The successful control program will reduce environmental damage from acidic deposition and will prevent future re-occurrence of damage. A source-based approach has the certainty of establishing a level of performance for controlled sources but the uncertainty of whether those control actions will improve the areas damaged by acidic deposition. No direct linkage between effects and source performance is maintained, and some areas may be "overprotected" while others may lack sufficient protection. This approach can provide substantial emissions reductions and a program that is relatively easy to administer, but it does not ensure a limit on emissions or the achievement of environmental goals.

An emission-based program provides assurance that expected $S0_2$ and NO_x reductions will be achieved and is driven largely by socio-economic concerns, but like source-based programs, it provides no direct linkage between effects and level of emissions.

Loadings- and effects-based control programs would control only those sources that are causing violations of deposition standards or producing damaging effects. Program effectiveness depends on States pinpointing and adequately controlling out-of-state sources. While technically and administratively complex, these programs would provide the benefit of targeting controls.

New Concerns

New concerns were raised as a result of investigating acid rain control programs. These concerns include some traditional concerns that are intensified largely by the greater transport of the pollutant and multistate operation of its sources, greater economic consequences, and a more obscure sense of the relationship between sources and receptors.

Socio-economic Decision-making

Controlling acid rain shifts the emphasis of economic and social concerns and increases their significance relative to the control of traditional pollutants. A fundamental new concern is that air agencies may be required to allocate controls among a pool of candidate sources without clearly defined source culpability. Particularly in the case of an emission-based program, air agencies may find themselves in the unfamiliar position of supporting control decisions primarily on social and economic grounds, rather than on air pollutant impact grounds, which is the primary basis used in managing traditional control programs.

Involvement of Multiple Agencies

Whenever a multifaceted problem is imposed upon an existing institutional infrastructure (that was not designed to handle the problem), the capabilities of the institutions may be mismatched with the problem. Task forces and *ad hoc* committees are convened as a way of assembling the needed blend of disciplines, often by drawing from the technical experience of agencies operating in a related field. Eventually, either an existing institution is broadened or a new one is created with a specific mandate to ensure the "right" blend of expertise and staffing. Program managers are concerned that the perspectives of their agency be accommodated and represented in the decision-making process.

The differences and complexities of acid rain control require new ideas on the role of the State agencies in controlling multistate pollution. To be effective, a lead agency should be designated to resolve problems which may arise where multiple agencies have overlapping or conflicting interests, responsibilities, and authorities.

Multistate Scale

Program managers are concerned that traditional State-based planning is complicated by the interstate nature of the transport of acid rain precursors and the interconnected nature of the electric utility industry. Given these complications, it is not possible to eliminate all interstate coordination problems. The following example illustrates one type of problem that could arise:

- A few generating plants located in one State are partly or wholly owned by other utilities in neighboring states. The State in which the plant is located could allocate a large emissions reduction to the plant owned by out-of-state utilities or serving customers in neighboring states, thus shifting the costs of compliance to out-of-state ratepayers. Moreover, under existing mandates to provide reliable service at the lowest possible cost, State PUCs could be obligated to shift costs in the manner outlined above.

Interstate issues arising from the electric utility industry would probably be least significant with a source-based program. However, the interstate nature of the electric utility industry becomes a significant factor under the other program types. For loadings- and effects-based programs, implementors are concerned that they must have explicit authority (as well as the practical means and resources) to compel sources outside their State to control emissions. Establishment of interstate agreements depends on the willingness of States to negotiate away some autonomy.

IMPLEMENTATION ISSUES

The primary purpose of the STAR Program was to investigate potential implementation issues under a Federally legislated acid rain control program and in the process, to prepare the States and EPA to carry out such a program. Given that most legislative proposals have focused on emission-based approaches, most of the STAR projects investigated issues that could arise under that type of program. Because of their lower source density and less immediate need to seek reductions, the Western States project (WESTAR) also looked at the implementation issues presented by a pollutant loadings-based program type. Many of the projects, particularly those that focused on control options and costs, would be applicable to all program types.

The following discussion summarizes the major implementation issues identified through the STAR Program and relates them to the program types and concerns outlined above.

State Goals and Design Philosophies

Some States found that they could design a control program to meet the letter of the legislative requirement and, at the same time, achieve State goals such as maximizing environmental benefit, minimizing cost to ratepayers or to sources, or minimizing employment impacts. New York State expressed an interest in developing a State plan that would meet not only Federal requirements but would also provide maximum protection to the acid-sensitive Adirondack region of that State. Pennsylvania identified a concern for protection of the local high-sulfur coal mining industry, which could influence development of compliance plans. Other state-specific goals might include minimizing control requirements on certain economically important industries, minimizing electric rate impacts on rate-sensitive industries, and promoting energy conservation or use of non-fossil energy sources.

Adequacy of Resources

STAR participants examined program elements and identified good barometers of resource intensity (i.e., type and number of sources to be controlled, amount and quality of data needed to support the control program, and difficulties of enforcement). These barometers are good indicators of the magnitude of resources required to implement and the complexity of the program.

Selection of the Type and Number of Sources

The narrower the coverage of a program (for example, only utility sources) and the fewer compliance options (for example, only fuel switching and scrubbers allowed), the less complex the program and, probably, the fewer resources required to implement. The broader the coverage of the program (mobile and all stationary sources) and the more flexibility allowed sources (e.g., trading emissions, using unproven control technologies, etc.), the more difficult and resource-intensive the plan will be to implement and administer. This relationship between resource requirements and program complexity holds for financial, human, and technical resources and overall development and administration of the program.

Data Requirements

The type of control program an air agency is asked to implement will influence the complexity of data gathering and analysis. Of the four program types, a source-based control program requires the least data for implementation. A traditional emissions inventory is not essential because the program could be implemented with limited data that identifies the qualifying sources (type, size, and street address), identifies existing controls and current emissions performance, and provides sufficient information to monitor compliance.

Many emission-based legislative proposals specify an emissions "baseline" as well as intermediate emissions milestones. To determine actual baseline emissions, an inventory must be developed of **actual** emissions. Many STAR projects provided valuable information about the magnitude of effort and resources required to adequately develop and verify emissions inventories and the data required to support economic modeling and socio-economic decision-making.

In addition to all of the information requirements of emission-based programs, loadings- and effects-based programs would require additional accurate temporal and spatial knowledge of emissions covering multistate regions. Development of a plan for a loadings-based program would require greater data gathering and analysis than either source-based or emission-based programs. In addition to all the requirements of a loadings-based program, an effects-based program would require still more data and analysis. Regulators would also need to identify ecosystems at risk and determine appropriate biologic indicators.

Enforcement

Enforcement would be straightforward under a source-based control program. An important asset for implementing source-based control programs would be further development and wider deployment of continuous emission monitors (CEMs) to minimize the enforcement burden and to ensure source compliance.

Emission-based programs could present additional enforcement burdens. Any approach that allows emissions trading, leasing, or other more administratively complex approaches (such as managed emissions dispatch), will require a significant additional commitment of enforcement resources. To avoid forced shut-downs near the end of an averaging period, Massachusetts examined a concept of "Dynamic Emission Management" with a goal of continuously tracking and, if necessary, adjusting the operation of sources to ensure ultimate attainment of annual state-wide average emissions targets.

Enforcement of loadings-based or effects-based programs must be implemented on an interstate basis. However, this may render programs impractical from a State perspective and significantly more complex and resource-intensive from a Federal perspective than either source- or emission-based programs.

Multiple Interests / Lead Agency

There are a number of State agencies and other interested parties that may want, or need, to be involved in developing a plan for controlling acidic deposition (e.g., State air, energy, and natural resource agencies, power plant siting boards, public utility commissions (PUCs), representatives from governor's offices and legislatures, utility and industry representatives, environmental groups, consumer advocates, Federal agencies including the EPA, the Federal Energy Regulatory Commission (FERC), and the Department of Energy (DOE)).

Public utility commissions (PUCs) will certainly be involved since most acidic deposition control proposals focus on the electric utility industry and consequent rate impacts. Failure to properly involve affected interests could lead to delays in implementing the plan, including protracted public comment, resistance to State enabling legislation, and legal challenges to the plan.

An interagency agreement or new State legislation may be necessary to clearly identify and empower a lead agency with primary responsibility within a State. A primary role of a lead agency would be to resolve conflicts that may arise where multiple agencies have overlapping interests and authorities. If possible, the lead agency should be the same agency that will plan, implement, monitor, and enforce the control program.

Interstate Coordination

Resolution of conflicts between States may require Federal administrative or judicial intervention, or some mechanism for interstate cooperation.

Unless some other agency is specified, the *de facto* mediator for interstate conflicts would be the EPA since, under all acid rain legislation proposed to date, the Agency would have responsibility for plan approval. However, EPA may not have the resources to assume this role and does not have extensive experience with utility regulatory issues.

Alternative solutions require legislative "fixes" to provide explicit mechanisms to foster communication among States and/or to resolve interstate issues and conflicts.

Credible Federal Default

A default provision provides a federally legislated back-up control requirement that would be known at the outset, before States develop control plans in response to legislation. A default provision would specify some *control certain* in the absence of timely State action (e.g., a 1.2 pounds of SO_2/mmBtu emission rate on a unit or plant basis). For a default provision to be credible, the Federal government must be able to implement and enforce it without State assistance and with comparable environmental benefit, tolerable economic and social costs, and a certainty of occurrence. Most default proposals preempt the more flexible (and frequently less-costly) approaches developed by States.

Most States, when faced with a credible Federal default provision, would try to avoid the more restrictive and costly default requirements and would make extra effort to ensure the timely delivery of an approvable control plan to EPA.

Timing

Results of working groups at the Asheville, N.C. workshop indicate that some States (particularly those with difficult control decisions and complex regulatory and legislative review procedures) could require a minimum of 24 months (and preferably 30) to develop control plans. Since that workshop, some States indicated that they are now in a better position to develop control plans because of the advance planning exercises of the STAR Program and that the plan development period might be reduced somewhat. On the other hand, results from a January 1989, workshop with State air agencies and public utility commissioners indicate that existing utility regulatory requirements might dictate more time for plan development.

Massachusetts suggested that the time required for acid rain compliance plan development and approval could possibly be shortened by *parallel processing* where EPA would receive intermediate results. This would allow the Agency to interact with State planning groups as the plan was being developed, rather than only after completion, as is currently the case.

Energy Conservation

Three primary issues surround energy conservation relative to acid rain control plans: 1) the ability of conservation measures to reduce the demand for electricity; 2) the relationship of these reductions in demand to emissions; and 3) whether a State will use conservation techniques prospectively to reduce future emissions, or retrospectively as control devices to reduce current emissions.

Magnitude of Reductions Achievable

Estimates of reductions in demand attributable to energy conservation measures vary greatly, mostly according to assumptions about the penetration of various measures. Massachusetts, NESCAUM, and Wisconsin specifically investigated the role that energy conservation might play in an acid rain control plan. These projects indicate that energy conservation offers potential for reducing emissions and/or the cost of control. Conservation techniques have a short payback period for residential, commercial, and industrial sectors, and may produce additional savings by eliminating or deferring capital construction of utilities. These States and Tennessee (with TVA) indicate that the attractiveness of conservation to utilities is greatest in regions with unmet demand (e.g., New England) and least in regions with excess generating capacity (e.g., the Midwest). Conservation is less attractive to utilities with excess capacity because implementing conservation measures may further increase their excess capacity.

Relationship of Emissions to Demand

The relationship between air quality and energy conservation is complex and sometimes counter-intuitive:

- With economic dispatch, cleaner (more costly) units are usually removed from the grid before the dirtier (and cheaper) units. For this reason, emissions reductions do not always follow demand reductions. Control plans that include energy conservation could allow mutual multistate benefits and could be fostered by development of regional emissions control requirements and a regional compliance plan.

- Implementing conservation measures may cause electric rates to increase because the fixed costs of a utility continue and must be met with revenues from reduced sales. This consequence is most likely in areas with excess generating capacity.

- One utility-sponsored conservation program involving appliance replacement had the unexpected effect of increasing the demand for electricity (and consequent emissions) because older appliances continued in service after being "replaced" with energy-efficient models. This finding underscores the importance of determining the effectiveness of conservation measures.

How States Might Accommodate Conservation in Control Plans

State air agencies may embrace conservation in two fundamentally different ways: either prospectively to reduce future emissions, or retrospectively (as one might retrofit control equipment) to reduce current emissions levels. The ramifications for a State air agency are significant.

If an agency uses conservation programs to reduce future emissions, there is no need for enforcement or for protracted rigorous study of effectiveness or penetration of various conservation measures. Discrepancies between **actual** and **projected** emissions may be accommodated by adjusting the mix of conventional emissions controls to supplement any shortfall in the performance of the conservation program.

If States use conservation measures as conventional controls to reduce existing emissions levels, the need for certainty in the deployment and performance of conservation measures presents a significant obstacle to their adoption by State air agencies. In addition to seeking reasonable assurance (of performance), the air agency must provide for sufficient monitoring and tracking of the performance of conservation measures to ensure defensible enforcement actions, if necessary.

Uncertain of the effect that conservation measures will have, air agencies may require back-up control plans to be used if conservation does not achieve the estimated effect in the required time. Sources may see such contingency plans as a discouraging extra layer of complexity. On the other hand, a credible back-up plan may encourage implementing the primary plan due to reluctance to adopt the back-up plan and accept defeat of the primary plan.

Interestingly, the term "conservation" is interpreted by disparate groups in a context which meets the need of the implementor. To utilities, conservation smooths peaks in generation, cuts capital requirements for new construction, and allows efficient use of existing capacity. To environmentalists, conservation usually means "using less."

Control Techniques

The choice of an appropriate control technique(s) for each source is an important implementation decision under any type of acid rain control program. This choice presents implementors with a number of issues, including performance, effectiveness, cost, and reliability.

New technologies promise greater control at less cost, but present the air agency and the source with a question of certainty (i.e., how can performance of an unproven technology be assured?).

Conventional Controls

Fuel switching is a clear option at boilers that can easily be converted from one fuel type to another. To evaluate the cost- effectiveness of coal switching relative to other control options, an estimate of future low-sulfur coal prices is helpful, but difficult, since the collective response of States to acid rain legislation will certainly influence the price of low-sulfur coal. The Midwest Research Insitiute (MRI) reviewed twelve STAR projects that investigated control techniques and their costs, and compiled an overview of State efforts entitled "Review of Methodologies for Estimating Control Costs for Acid Rain

Precursors." This report reviews available methods for estimating the cost of SO_2 controls fitted to utility boilers and is intended to assist air agencies in identifying cost methodologies that may best fit their needs and resources.

Clean Coal Technologies

The Clean Coal Technology (CCT) Program was created by Congress to assist the development and commercial-scale demonstration of less-polluting, more efficient, and less costly control technologies for sources burning primarily high-sulfur coal. CCT could play a role under any type of acid rain control program, but States and sources must decide whether CCTs will be incorporated in the range of control options considered for each facility. Depending upon their cost, the status of their commercial demonstration, and compliance deadlines in Federal legislation, States may want to provide for inclusion of CCTs in the control program.

Managed Emissions Dispatch

Managed emissions dispatch operates in a manner similar to economic dispatch except that generating units are brought "on-line" with consideration of their emissions. Currently, the emissions characteristics of generating units are considered only to the extent that the cost of operating control equipment is reflected in the overall cost of operation of each unit (i.e., its rank in the dispatch order).

Best suited to emission-based control programs, managed emissions dispatch could operate under any of the other program types. With loadings- and effects-based programs, this approach could create difficulties, however, since the spatial distribution of pollutants would constantly change as the dispatching system responded to demand. To successfully employ managed emissionsdispatch, a State air agency would need to work closely with the central dispatcher to develop a new "sorting" protocol which would fundamentally revise current dispatching practice. The development of the environmental dispatching protocol would likely require expertise and resources not readily available at many air agencies. Multiple issues need to be resolved before managed emissions dispatch could be implemented.

Emissions Trading

If allowed by legislation, emissions trading could operate under any of the four program types but would be best suited for emission-based programs. Theoretically, emissions trading provides flexibility and potential cost reductions, while having minimal impact on the achievement of the environmental objectives of a regional pollution problem. Since pollution control costs vary from source to source, trading would allow sources that could reduce emissions inexpensively to sell or lease additional emissions reductions to sources that find reaching even their required reductions too costly. This would allow a State to achieve lower-cost compliance.

Barriers to trading include: considerable administrative and enforcement resources for the air agency; participation of enough buyers and sellers; potential need for incentives; and reluctance of utilities to participate due to uncertainty about how their PUC might treat trading revenues and costs. Massachusetts investigated emissions trading in detail in their STAR project and concluded that this approach looks promising for the control of acid rain because potential savings increase as the trading area becomes larger and less restricted. However, regulators reported trade-offs between source flexibility and regulatory oversight requirements; regulatory costs increase as trading becomes more complex. Management difficulties expand with geographic scale, particularly when two or more States become involved.

SUMMARIES OF STAR PROJECTS

Final reports of the STAR projects are now available with summaries prepared by the States or EPA. Chapter 4 is a guide to the complete set of STAR project reports. Key words relate to the focus of each State STAR project; these are grouped into seven broad categories:

- Control Approaches
- Basic Information Requirements
- Control Technologies
- Other Compliance Strategies
- Compliance Planning
- Industrial Controls
- Monitoring and Enforcement

Most of the STAR projects investigated more than one issue. Popular issues investigated by the STAR projects include: planning criteria (17 projects), use of flue gas desulfurization (scrubbers) (12), use of fuel switching (15), and development or validation of emissions inventories (13).

Appendix A provides brief (1- to 4-page) summaries of the individual STAR projects.

USEFULNESS OF THE STAR PROGRAM

Without the force of regulation and recognizing the many regulatory activities that demand States' attention, EPA's challenge was to constructively engage the States in a contingency planning effort. EPA also sought information which most participants were not accustomed to providing (i.e., to think creatively outside the boundaries of conventional program requirements; to think about difficulties that might arise from managing a regional pollutant like acid rain; and to report information gleaned from unsuccessful as well as successful investigations that could be useful to other States).

To facilitate interchange between States and their Federal counterparts, management approaches were designed to enhance communication with the States as well as to provide current information on the status of all projects. National workshops, informational memoranda, computerized public-access bulletin boards, and enhanced coordination with STAPPA/ALAPCO were used in addition to conventional report writing. To determine the States' opinion of the usefulness and overall management of the STAR program, EPA retained the third-party consulting firm of ERM-Rocky Mountain to solicit views of the States on the program.

States identified workshops as the single most effective program management tool and indicated that workshops surpassed initial expectations. The national workshops served as excellent forums to initiate and continue personal contacts among STAR project participants and EPA staff, and to exchange specific ideas on project direction and results. Participants indicated that the workshops (particularly the second at Asheville) were extremely effective in broadening program understanding and support and provided the best possible mechanism to interact with peers to "brainstorm" implementation ideas. Participants particularly appreciated the implementation planning exercise of the Asheville workshop and suggested that the single most important transferrable element from the STAR Program is the use of workshops designed with a significant role for participating States.

EPA's effort to involve STAPPA/ALAPCO from the beginning of the STAR Program was identified as the second most successful management initiative. STAPPA/ALAPCO helped focus the STAR program, reviewed State projects for funding, and provided ongoing communication with the States. This mechanism proved effective in increasing communication with States and project "networking." STAPPA/ALAPCO sent a questionnaire to the States to solicit their views on the management of the STAR Program and facilitated its return.

A criticism of the management approach of the STAR Program was the unusual level of freedom provided participants to explore ideas and new approaches. In general, States complimented the interactive management approach which generated a level of trust in the process not always found in State/EPA relationships. Both States and EPA believe that the Agency can benefit from the STAR experience in future relationships with States and that the Agency should be alert to potential new program areas early enough so that exercises like STAR may be utilized.

CHAPTER 1

INTRODUCTION

In 1983, when EPA conducted a thorough review of the acid rain issue, it was apparent that the problem as it was coming to be understood, did not match well with the existing statutory authorities and institutions established to deal with air pollution. Although solutions were being proposed, EPA was concerned that neither EPA nor the States were well prepared to implement any then-current legislative proposals to control acid rain. It also appeared that even though a decision to control acid deposition was not certain, the substantial cost of this potential decision suggested that the prudent course was to undertake some contingency planning.

This mismatch between the proposed solutions and existing infrastructure to carry out those solutions appeared to be a function of 1) the nature of the acid rain problem, in particular, its geographic scale, 2) the multistate operation of the principal sources of acidic deposition, and 3) the jurisdictional limitations of state and local air pollution control agencies.

GEOGRAPHIC SCALE OF ACIDIC DEPOSITION

A unique combination of location of coal deposits, industrial development, technology, population, geographic size of states, rainfall patterns, and glacial history create an acidic deposition problem for the mostly thin granitic soils in the Northeast and Canada that are downwind of major combusters of high-sulfur coal. By geologic circumstance, huge deposits of high-sulfur coal are mined in the Midwestern U.S. and burned to produce electricity and steam for industrial processes. Coincidentally, the combined climatologic effects of planetary circulation, the jet stream, and the Great Lakes cause many weather fronts (with attendant precipitation) to travel from the Midwest to the Northeast.

Combustion products (particularly sulfur dioxide and oxides of nitrogen) are emitted. Some are carried by the atmosphere and transformed with the help of sunlight into sulfates and nitrates and other sulfur-particulate-complexes, which then settle or wash out of the atmosphere. Some sulfur and nitrogen combustion products settle out of the atmosphere as dry deposition closer to the combustion source. Transformations of gaseous sulfur dioxide to sulfates and sulfur-particulate-complexes require three days, on average, to occur. During this time, large-scale atmospheric motion transports the pollution 300 to 500 or more miles downwind (assuming typical trajectories), thoroughly mixing individual plumes. Gaseous oxides of nitrogen convert more quickly than sulfur dioxide; therefore, the effects of nitrogen emissions are seen closer to the source of emissions, but still typically

100 to 300 miles away. At the longer downwind distances, the probability increases that the converted combustion products will be washed out of the atmosphere by rainfall.

Once deposited, the effect of acidic combustion products is often masked by the ability of many soils to neutralize or buffer the acidic deposition. The response of soils and watersheds to acidic deposition is complex and continues to be investigated and reported by the National Acid Precipitation Assessment Program (NAPAP).

While the greatest extent of damage is occurring on glaciated soils of the East, the thin soils and watersheds of the West are also at risk because they have even less capacity to neutralize acids. Many high-mountain lakes in the West are characterized as "granite bathtubs," where the quality of lake water directly reflects the quality of local precipitation. Even though many Western lakes are sensitive, they are not chronically acidic, and current levels of acidic deposition are relatively low. Periods of temporary acidification and recovery are documented in conjunction with spring snowmelt and summer storms, but potential damage resulting from these episodes is highly uncertain. If SO_2 or NO_x emissions were to increase substantially in the West, then the potential for damage would increase.

Also, the soils of the South are currently adsorbing and retaining sulfur deposited there, and at some point, when the soils become saturated, the sulfates will pass through to the aquatic systems and acidify them. Recent surveys of lakes by the National Acid Precipitation Assessment Program revealed no acidic lakes in the Southern Blue Ridge. However, a complementary survey of streams in the Mid-Atlantic and Southeast did reveal significant numbers of acidic streams in the Southeast region. A number of lakes were found to be acidic in Florida, but the chemical composition of some of these lakes may be largely related to land use practices and the natural decay of vegetation. Although acid rain is not yet implicated as a direct cause of forest decline, concern exists about the health of the forest resources in the Southeast, particularly because of the concentration of commercial forests in that region.

MULTISTATE OPERATION OF THE SOURCES

More than two-thirds of total SO_2 emissions (23 million tons in 1985) and about one-third of NO_x emissions (21 million tons in 1985) come from electric utility sources. Because of this and because of the inherent administrative difficulties and costs of controlling a large number of smaller, and generally more stringently controlled, industrial, commercial, and residential sources, virtually all proposed SO_2 reductions have been directed at electric utilities. To control electric utilities for regional benefit requires knowledge of the interstate nature of utility operations.

Electric utilities often serve customers in more than one state, and several large utility holding companies cover multistate regions. Many utilities are also members of one or more power-pools that facilitate the exchange of power among the member utilities. Generating units in the power-pool are dispatched by a central controller based on minute-by-minute evaluations of supply and demand and cost-of- generation. Demand is generally

met first with the generating unit in the pool that is least expensive to operate. Increases in demand are met by selecting (in dispatch order) additional generating units in order of ascending cost of operation. Addition of pollution control equipment increases the cost of operation. This usually lowers that unit's rank in the dispatch order and, therefore, its utilization. Conceivably, a downwind State could apply controls to a generating unit within its jurisdiction, only to have that unit used less frequently because the load shifted to an uncontrolled upwind out-of-state utility. Without close interstate coordination, the receiving State could experience both increased pollution levels and increased cost of electricity to ratepayers. This and other examples (discussed more completely in Chapter 3) underscore a fundamental difference between acid rain and traditional pollutants: the increased complexity of regulating interstate sources through existing state-wide institutions.

JURISDICTION OF CONTROL INSTITUTIONS

Geographic Scope

Existing air pollution control programs rely heavily on the action of State and local governments. The Federal Clean Air Amendments of 1970 engage States in an effort to attain the national goal of protection of health and welfare more quickly. The current Clean Air Act, Section 110, requires States to adopt and submit to the Administrator of EPA, "a plan which provides for implementation, maintenance, and enforcement of" any primary or secondary National Ambient Air Quality Standard (NAAQS) established by EPA. Success of the current ambient air program is measured by attaining and maintaining concentrations of traditional pollutants in the atmosphere at ground-level. The original intent of this measurement protocol was to protect the health and welfare of the most sensitive population at nose-level. At first, some pollution sources responded to the concentration standard by crafting "solutions through dilution;" the early 1970s witnessed the introduction of automotive air pumps and tall utility smokestacks as air pollution control devices. While these responses may have accommodated the immediate goals of attaining the ambient air standard, they did not limit the total mass of pollution entering the atmosphere nor did the tall-stack response prevent long-range atmospheric transport. Nonetheless, the primary focus of State control programs since 1970 remains the attainment and maintenance of the NAAQS, carried forward by enabling State authorities provided to each air agency by their respective legislatures to protect the health and welfare of in-state residents.

Existing State authorities are designed to resolve in-state pollution problems, not interstate. The current Clean Air Act is not well suited to accommodate the large geographic scale of acidic deposition, nor does it provide sufficient authority to enable one state to require emissions reductions from sources in another State without EPA assistance. Few provisions are directed toward interstate pollution. Section 123 (1977 Amendments) was intended to reduce general atmospheric loadings by restricting the dispersion benefits of tall smokestacks and other dispersion techniques. Section 126 of the CAA provides authority which allows a state to "petition the Adminisitrator [of EPA] for

a finding that any major source emits or would emit any air pollutant in violation of the prohibition of Section110 (a) (2) (E) (i)." This portion of Section110 prohibits "any stationary source within the state from emitting any air pollutant in amounts which will prevent attainment or maintenance by any other state of any . . . ambient air quality standard, or interfere with measures ... to prevent significant deterioration of air quality." A debate over the intent of Section 126 centers on the question of whether this section is intended to address localized problems (where a single-source contributes to violations of the NAAQS just over the border of a contiguous state), or whether Section126 provides broad authority for multi-source emissions reductions over an entire geographic region. Despite best efforts to deal with interstate pollution, current regulatory practice continues to place the heaviest burden for attainment of ambient standards on the State in which a violation occurs, regardless of the point of origin of the emissions which cause the violation.

Use of the existing State air agencies to control sources that typically operate at multistate scales and have out-of-state impacts is generally beyond the jurisdiction and authority of a single State air agency, and represents a mismatch of problem solution and authority. In the absence of new Federal and State enabling legislation, controlling out-of-state emissions could require regulators to establish either an interstate compact or an interstate agency to determine and enforce specific requirements. Establishment of such an interstate agreement or agency would most likely have to be ratified by state legislatures and Congress.

Socio-economic Dimension

Unlike the control of traditional air pollutants where reasonably clear source-receptor relationships and source culpability can be established on a local scale, allocating regional emissions burdens presents State air agencies with an expanded scale of coverage and an expanded socio-economic dimension to their control decisions. Programs for regional control of SO_2 are likely to resemble ozone control programs rather than traditional programs for attaining ambient standards.

An expected consequence of controlling utility sulfur emissions is that many sources will switch from higher- to lower-sulfur fuels, with expected concommitant changes in coal mining employment. Job losses in high-sulfur coal producing regions are likely to increase steadily as SO_2 emissions are reduced by the first 4 to 6 million tons due to fuel switching. There are few additional job losses as SO_2 emissions are reduced more than 8 million tons because additional reductions can only be achieved through technological controls such as flue gas desulfurization (FGD or scrubbing), rather than by fuel switching. Even though decreased mining of high-sulfur coal may be offset by increased mining of low-sulfur coal, these fuel resources generally occur in geographically different areas (far enough apart that miners would be forced to relocate).

A NEW RESPONSE

All of these fundamental differences between acid rain and traditional pollutants suggest that an institutional response to acid rain control might be fundamentally different as well. Many conventional implementation issues will be complicated by the interstate nature of the pollution, the multistate extent of the operation of emitters, and the mismatch of scale between pollutant, sources, and the state-wide jurisdiction of the regulating institutions.

THE STATE ACID RAIN (STAR) PROGRAM

From the concern that neither EPA nor the States were well prepared to implement legislative proposals to control acid rain, EPA developed a concept to voluntarily engage managers of air pollution control programs to examine implementation issues. The varied experiences and perspectives of air directors were needed to develop a better understanding of the potential difficulties and problems that might be encountered at all levels of government if control legislation were passed by Congress.

In late 1983, the U.S. EPA, through its Task Force on Acid Deposition, specifically recognized implementation and management issues as important to any acid rain program, regardless of the shape that legislation might eventually take. This recognition was supported by the the history of implementation of air pollution control programs in the United States, which suggested that any effective acidic deposition control program would rely heavily on the States for implementation. At that time, most Congressional legislative proposals focused on emissions reductions that are planned and enforced by States.

In late November 1983, a concept paper proposed that EPA, with State and local air pollution control agencies, undertake a project to work cooperatively with a volunteer State to develop a prototype State acid rain control plan. In January 1984, in his State of the Union message, the President announced that the Administration would work with the States on acid rain issues; and in February 1984, EPA Administrator Ruckelshaus, in testimony, elaborated on that commitment. By the Spring of 1984, the implementation concern had evolved into a broader concept that would seek the perspectives of multiple States.

EPA and the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) met in May 1984, to discuss participation of State and local agencies in this effort. The mechanism for State and local input and review was discussed along with methods for evaluating various options for dealing with issues. By August 1984, the first in-depth compilation of (209) potential implementation issues emerged as a document entitled "Potential Acid Rain Control Program Implementation Issues." This document did not attempt at that point to present options or solutions, but provided a comprehensive listing of issues.

Congress authorized $3 million in State air grant funds (Clean Air Act Section 105) for the development of "the technical and institutional foundations for future acid rain control strategies." In consultation with STAPPA/ALAPCO, letters of invitation were sent to State and local air directors to solicit proposals from each air agency. Many States responded with enthusiasm and, by November 1984, some $6 million in grant proposals were received. EPA and the STAPPA/ALAPCO Acid Rain Implementation Task Force reviewed the proposals, and EPA ranked them according to evaluation criteria. After consulting with STAPPA/ALAPCO, the EPA made final selections and allocated $2.7 million to them in December 1984. The remaining $300,000 was held as a contingency until December 1985, when it was allocated to projects. The first awards were made to New York, Wisconsin, Connecticut, and the Northeast States for Coordinated Air Use Management (NESCAUM) in March 1985. A total of 47 projects were funded over the course of what become known as the State Acid Rain (STAR) Program.

Recognizing State participation as voluntary, EPA committed to keep the Program "policy neutral," by deliberately taking no position on the policy question of whether or not there should be an acid rain control program. Each STAR project was thoroughly reviewed and changes were negotiated with each State on a case-by-case basis. Most work plans were adjusted so as to better focus projects on the special constraints of the funding and to integrate the projects to reduce (and in some cases, ensure) redundancy on issues. Some proposals required modification to keep them policy-neutral; and several spawned follow-up studies. Throughout the course of the STAR Program, EPA Regional and Headquarters staff provided advice, but in general, States were left largely on their own to explore ideas and new approaches.

When the STAR Program started, EPA found only one state actively planning for contingencies and investigating acid rain implementation issues. The Maryland Power Plant Research Program provided an excellent example of State-funded on-going strategic planning with a mission of identifying and assessing emerging issues and future program needs.

Since the STAR Program started, other similar studies have been initiated both within and independent of State government. The State of Ohio started work outside of the STAR Program to investigate how Ohio might reduce SO_2 and NO_x emissions. This effort helped the State work with New York in the development of the Cuomo-Celeste Acid Rain Proposal, an agreement between Governors Cuomo of New York and Celeste of Ohio for mutual environmental benefit. The Ohio Office of the Consumers' Counsel released, in July 1988, a report on the impacts of energy conservation on sulfur emissions reduction programs for Ohio electric utilities, entitled "Clearing the Air: Using Energy Conservation to Reduce Acid Rain Compliance Costs in Ohio."

The Center for Clean Air Policy managed a project funded jointly by the Tennessee Valley Authority (TVA) and the American Electric Power Company (AEP) to look quantitatively at opportunities to substantially reduce emissions of SO_2 and NO_x through aggressive conservation of electricity and improvements to generation efficiency. In another study, the Center investigated how different control options may influence the price of electricity and coal mining in West Virginia.

Given this background, Chapter 2 of this report provides a structure for evaluating program implementation issues. Chapter 3 uses this structure to examine them as they evolved through the conduct of the 47 STAR projects and through numerous discussions with State officials.

CHAPTER 2

IMPLEMENTORS' CONCERNS AND PROGRAM TYPES

This chapter describes four general types of acid rain control programs and the concerns that program administrators are likely to have if they were asked to carry them out. The *Program Types* and *Concerns* are used to provide a foundation for Chapter 3 where the nature and significance of potential implementation issues are examined.

FOUR BASIC TYPES OF CONTROL PROGRAMS

A goal of all acid rain control proposals is to reduce or eliminate damage from acidic deposition. However, the objectives that control proposals set for the program administrator can be quite different. They can affect not only the cost and feasibility of implementation, but also the likelihood of achieving the goal.

Legislation can define program objectives broadly as in Section 115 of the current Clean Air Act which simply requires governors "to prevent or eliminate . . . endangerment of the public health or welfare in a foreign country" when that endangerment is caused by pollutants emitted in the U.S. Or, the legislation can define objectives narrowly as in Section 111, which specifies detailed performance standards for specific kinds and sizes of new stationary sources. For State program implementors, the specificity of Section 111 removes the burden of deciding the "right" level of control for each source, but at the expense of limiting flexibility. The broadness of Section 115 provides tremendous flexibility in developing an approach (to prevent or eliminate endangerment) yet imposes a substantial administrative burden of analysis, plan development, and enforcement to ensure that the objective is attained.

In 1984, in the absence of acid rain control legislation, EPA took the opportunity to examine what implementation issues might arise in a future acid rain control program and how they might differ from the issues presented by the current air pollution control program. Fundamental differences in the scale and complexity of the environmental problem itself suggested that different institutional responses might be appropriate.

In the process of investigating implementation issues through the STAR program, a structure emerged which provides a convenient architecture for examining not only regional pollutants like acid rain, but environmental control programs in general. This taxonomy of control programs, as seen from an implementor's perspective, consists of four basic types: source-based, emission-based, loadings-based, and effects-based.

Source-based Control Programs

Source-based control programs are directed at the operation of emissions sources. These programs emphasize the enforceability of control requirements. Meeting a specific performance standard or emissions rate is the hallmark of this program type, as illustrated by the example of Section 111 above. Other examples are provided by existing air pollution control elements, such as Reasonably Available Control Technology (RACT), Best Available Control Technology (BACT), Lowest Achievable Emission Rates (LAER, representing the best control performance achievable through state-of-the-art technology), and emissions standards for cars and trucks.

Source-based programs are not necessarily linked directly to hardware or technology. Specifications of an emissions rate (pounds of SO_2/ mmBtu, percent sulfur-in-fuel by weight or by volume, grams of pollutant per mile traveled, for example) provide for a level of performance without directly addressing the choice of hardware required to attain this standard. Source-based programs are typically linked to the operation of a combustion source at the unit-level, on a short-term basis, and are independent of the degree of unit utilization. Total annual emissions from a facility could change significantly while still maintaining an hourly rate or fuel specification. For example, under the Federal Motor Vehicle Control Program, the emissions performance of an automobile is specified (in grams of pollutant per mile), but the program does not limit vehicle use (total vehicle-miles-traveled) and consequently does not limit total emissions per year.

One legislative proposal which focused heavily on the source-based approach was Senate Bill S. 300, which was introduced by Senator Stafford in 1987. It called for tightening performance standards for new stationary and mobile sources and establishing stringent performance standards for existing sources to go into effect after thirty years of source operation.

Under source-based control programs, the implementor is successful if each source meets its performance standard. The implementor does not need to ensure that regional emissions goals or deposition levels are achieved.

Emission-based Control Programs

Emission-based control programs focus on reducing total emissions over a defined geographic area such as a state, a multi-state region or the entire nation. In an emission-based program, the objective may be stated as an emissions reduction target (typically tons-of-pollutant per year) or as an emissions ceiling. Responsibility for achieving the emissions goal is usually assigned to the States for administrative reasons.

To manage an emission-based program, regulators must provide sources with measurement protocols and collect data to estimate total emissions. One distinction between source-based programs and emission-based programs is the averaging time over which measurements are taken: emissions rates of source-based programs are linked to source operation and are typically expressed over short averaging times (e.g., per hour-of-

operation); emission-based programs are typically expressed over much longer averaging times (e.g., on an annual basis). Day-long or week-long excursions above an emissions rate can be accommodated easily in the longer averaging time of an emission-based program.

Another distinction beween the source-based approach and the emission-based approach is the greater flexibility that regulators and affected sources have in choosing emissions controls. Under an emission-based approach, sources may be able to use emissions trading and leasing, fuel switching, changes in rates of production, installation of control equipment, as well as receiving credit for emissions reductions resulting from energy conservation efforts and efficiency improvements. As long as the total tonnage of emissions is reduced by a specific amount or kept below a specified threshhold, the program objective is achieved.

Pollutant Loadings-based Control Programs

With a pollutant loadings-based control program, the objective is to limit the amount of a pollutant affecting the environment. For example, the current air program uses National Ambient Air Quality Standards (NAAQS), which are typically expressed as mass-of-pollutant per volume of ambient air. Meeting the NAAQS should protect the health and welfare of the most sensitive individuals and the environment. For acidic deposition, such standards (typically defined as mass per surface area; for example, kilograms of sulfate or nitrate per hectare) could be set to ensure that adverse impacts of acid deposition would not occur to sensitive resources.

Setting a deposition standard would not mandate a specific control technology for a source or fix a level of emissions for a region. This flexibility enables regulators to select from the same range of control strategies as the emission-based approach, but in addition, the implementor can specify an emissions reduction necessary to meet the deposition standard. A substantial administrative and scientific burden also accompanies this flexibility since many combinations of source reductions and aggregate emissions levels could achieve the standard under various meteorological conditions. Also, it may be desirable to vary the standard to reflect the widely varying sensitivities of affected resources in different geographic regions.

Regardless of whether a deposition standard is constant or variable, the technical and scientific tools do not exist currently at the operational level to enable this approach. For purposes of implementing this type of acid rain control program, operational state-level, long-range dispersion models do not yet adequately simulate chemical transformations and air-mass trajectories. This, combined with lack of adequate knowledge of critical damage threshholds for various species, has the result that few programs based on deposition standards have been proposed.

Although S.1894, reported out of the Senate Environment and Public Works Committee in 1987, directs the study of acidic deposition standards, none of the Federal legislative proposals to date uses deposition standards as an objective of a control program. However, the State of Minnesota did establish a State control program based upon a

deposition standard of eleven kilograms per hectare per year and specified that emissions reductions are required only of those sources determined to be contributing to the violation. Since Minnesota sources contribute only about 10% of current sulfur deposition, Minnesota air officials estimate that reducing emissions in other States is essential for attainment of their deposition standard. Minnesota's lack of authority to control sources in other States highlights one of the difficulties of achieving success with the pollutant loadings-based approach.

Environmental Effects-based Control Programs

The emphasis of an environmental effects control program is to protect the most sensitive human beings, flora, and fauna from the deleterious effects of pollution. Success is measured by the health and quality of the sensitive resources themselves. For example, for acidic deposition, program objectives might be expressed in terms of maintaining the diversity and quantity of a fish population or the quality and productivity of a forest. Meeting these biologic standards would add yet another layer of complexity to the job of the program implementor.

Effects-based control programs would require complex analytic tools and data in order to: identify sensitive areas and species; identify the level of pollution that each species can tolerate without suffering deleterious effects; specify the biologic standard to be achieved; monitor species and ambient pollutant levels to determine whether the effects threshhold is exceeded; use a method (model) for linking effects to causes (points of emission); and identify and ensure specific emissions reductions that are sufficient to remedy the deleterious environmental effects.

With this program type, a State regulator would have great flexibility in devising strategies so long as the net result is protection of sensitive resources. However, administrative and scientific burdens would also be great because the implementor must use and defend all the relationships noted above. In addition to all of the complexities of pollutant-loadings based programs, effects-based programs would require intimate knowledge of all organisms in the region affected by the pollution. These complexities are a primary reason that no acid rain proposals have utilized this type of program.

Current air programs that come closest to an effects-based approach are Sections 115 and 165 of the Clean Air Act. Section 115 has as its objective the prevention or elimination of the endangerment of public health or welfare in foreign countries from pollution emitted in the United States. It defines only the effect-related objective and leaves all subsequent steps to the implementors -- EPA and the States. Section 165 requires that "air quality related values" be protected in wilderness areas and national parks when new sources are permitted. Again, defining and meeting that objective is left to the Federal implementors.

Increasing Complexity

By examining the program types from the perspective of those charged with implementation, it is clear that the job of implementation becomes more complex with each layer of action and judgment required of the implementor, particularly when scientific and regulatory uncertainties are large. As the length of the scientific chain of causal relationships increases, so does overall institutional complexity. The greater the number and complexity of administrative decisions, the greater the risk of challenge, and timely implementation becomes less feasible.

CONCERNS OF PROGRAM IMPLEMENTORS

Utilizing insights gained from the STAR program, the balance of Chapter 2 describes the likely concerns of program implementors when confronted by the requirement to carry out a new control program.

Drawing from State and Federal air pollution control experience, a number of "traditional" concerns are identified as important to managers when new programs are instituted. Primary among these concerns are:

- Adequacy of resources: financial, human, and technical
- Administrative complexity
- Interaction with/effect on existing air programs
- Contentiousness of the new control program: equity and cost, flexibility, and efficacy.

STAR investigations reinforced the importance of these traditional concerns and identified new ones specific to acid rain control. Important "new" concerns were expressed as "needs:"

- Need for socio-economic decision-making in addition to air quality planning
- Need to involve multiple agencies and designate a "lead" agency
- Need for interstate cooperation.

By examining both traditional and new concerns of program implementors through the structure provided by the *Program Types*, the implementation issues and institutional responses to an acid rain control program presented in Chapter 3 should be clear.

Traditional Concerns

Financial Resources

When program managers are faced with the prospects of incorporating a new control program into an existing one, a universal concern is whether sufficient additional funds will enable them to fulfill additional responsibilities and duties. A key issue in formulating an administrative response to a new charge is whether the burden must be accommodated within existing funding levels or whether the new charge brings additional funding for implementation.

Human Resources

Parallel to the above issue, program managers are concerned whether the burden of a new program must be accommodated by existing staff or whether the new charge brings additional specialized personnel. If a program manager faced severe staffing limitations, it would be necessary to determine whether current staff provides the "right" mix of talent to implement the new program. Assuming that funding permits additional staff, implementors are concerned with the size of staff required to implement; what "lead" times will be required to hire new personnel; what level of staff expertise and skill will be required to implement the program; what specialized training will be required; what kinds of decisions staff will be expected to make; and how much judgment will staff be required to exercise in implementing the program.

Technical Resources

Program managers are concerned about the adequacy of the technical infrastructure of their program and whether new or specialized equipment may be required. Typical concerns are driven by the kind of demand (type of control program) that is anticipated to implement the program (e.g., sufficient computer capability, monitoring capability, and laboratory capability and access to analytic equipment).

Administrative Complexity

Administrative complexity is influenced by the number of decisions that are required in implementing a program and the difficulties encountered in making those decisions. Decision-making may be complicated by lack of information, conflicting information, uncertainties in the quality and reliability of the data, an even weighting in the balance of the "pros" and "cons" of the options, lack of clear alternatives, concern with "downside" risk, and conflict of interest. The administrative complexity of a program also

may be influenced by the amount of flexibility that an agency can exercise in implementing it. Added flexibility often leads to greater complexity and greater regulatory responsibilities, such as:

- Selecting and defending a control approach
- Establishing and defending a proper control level
- Determining what data is necessary to implement, and then collecting and analyzing it
- Administering and monitoring all aspects of the selected control approach (e.g., establishing an emissions trading protocol and tracking results; approving design of emissions controls and scheduling their installation)
- Monitoring source compliance with emissions limits.

An administratively simple program can fail to achieve its goal and will need revision if it is not crafted carefully to ensure that it goes forward smoothly and effectively. Multiple revisions of a simple program can increase administrative complexity, too.

Effect on Existing Programs

Implementors are concerned with the effect that any new charge or responsibility may have on their ability to successfully administer current responsibilites. They are particularly concerned that the burden may be placed on existing staff if a new program is added to the old, and the extra burden may hinder successful administration of existing programs. Administrators also express concern that one program may conflict or interfere with another. Since many sources are controlled for multiple pollutants and multiple purposes, the potential for conflict or interference is great. Examples are abundant: enforcement to meet an annual emissions target would need to coexist with enforcement to meet a short-term ambient air standard. Administrators must reconcile these two goals without creating confusion for the source and/or the enforcement staff. A new air program can affect other environmental programs and emerging concerns: a scrubber installed for attainment of ambient air standards may produce waste which complicates the job of implementors seeking to improve the quality of ground water; baghouses installed to reduce particulate emissions produce fly-ash which places additional burden on landfills; scrubbers impose an energy penalty on the operation of an electric utility such that the net heat rate is increased — causing attendant increases in CO_2 emissions, which affects global climate.

Contentiousness of a New Control Program

Implementors are concerned with how smoothly a new program goes forward to solve the problem it was designed to remedy. Administrators wish to minimize the likelihood of conflict, protracted debate, or litigation from sources, environmental groups,

consumer advocates, industry, and/or other State agencies. Conflict or protracted debate diverts limited resources away from implementation and usually delays achievement of the environmental goal. Contentiousness of a control program is a function of perceptions of equity, flexibility, and efficacy of the control plan.

Equity. Implementors want to ensure that their control efforts are perceived as reasonable and fair from the perspective of all affected parties. Most discussions of equity center on how the costs of regulation are allocated and who will benefit. For local air pollution problems, the polluter has traditionally paid for the cleanup, and the nearby area has benefited. But under an acid rain control program, where source attribution would be problematic and the benefits of control would fall over a large area (much of which would be distant from the source), the issue of "who pays" is complicated. Opinions differ on how to allocate the costs fairly and what role States should play in making these determinations.

Flexibility. With the ambient control program, administrators see two kinds of situations with two kinds of responses. In rural areas where large SO_2 sources dominate, source culpability is relatively easy to determine. In such circumstances, the "flexibility" that States exercise is limited to determining what remedy is reasonable to ask of the identified source (i.e., what control equipment or control actions are appropriate). In metropolitan areas, the sheer number of sources presents the State with a different kind of "flexibility." In these circumstances, pollution controls could be placed on a multitude of source types and sizes, and the air agency has considerable discretion in determining which source(s) will bear a control burden and how that burden will be implemented. A typical response of a control agency to excursions above the ambient SO_2 standard is to prescribe a common limit on the sulfur content of fuels for all sources in the entire metropolitan region. For traditional ambient air programs, flexibility is a concern, but not a preeminent one.

This traditional concern for flexibility takes on new importance with potential control actions for acid rain because allocation decisions need to be made among candidate sources as opposed to for a specific source or across all sources. Faced with allocating acid rain controls among sources, many State implementors have expressed a desire for the flexibility to choose among a pool of available controls with consideration of the economic consequences of those controls on the particular company, industry, locale, and/or State.

Efficacy. Implementors are concerned with how well their programs solve the problem(s) they are designed to remedy. Implementors want to be able to show that their control programs are effective and worthy of being continued and supported. For traditional control programs, ambient air monitoring serves to demonstrate the efficacy of local control efforts; but with acid rain, it is harder to link changes in deposition with a State's control activities.

New Concerns

The fundamental differences between acid rain and traditional pollutants described in Chapter 1 elevate some of the traditional concerns to much greater prominence; these are expressed as "new" concerns. Central to these new concerns is implementors' belief that air agencies may be required to allocate controls among a pool of candidate sources without the supporting benefit of clearly defined source culpability. Driven largely by the multistate nature of the pollutant, the interstate operation of its sources, higher economic stakes, and a more obscure sense of the relationship between sources and receptors, new concerns identified by participants in the STAR Program include: socio-economic decision-making, multiple and lead agencies, and interstate cooperation.

Socio-economic Decision-making

Controlling acid rain shifts the emphasis of economic and social concerns and increases their significance relative to the control of traditional pollutants. Particularly, if the burden for making allocation decisions is placed on the States, air agencies may find themselves in the unfamiliar position of supporting control decisions primarily on social and economic grounds, rather than on air pollutant impact grounds, which is the primary basis used in managing traditional control programs.

These additional responsibilities may require additional types of skills, and will probably involve more and different participants than during previous efforts to control conventional pollutants. For example, few air agencies have personnel with the skills required to use economic models that estimate costs and employment impacts of various acid rain control scenarios on the electric utility and coal industries.

Involvement of Multiple Agencies

Frequently, when a multifaceted problem is imposed upon an existing institutional infrastructure (that was not designed to handle the problem), there is a mismatch between the capabilities of the institutions and the problem. "Task forces" and "ad hoc" committees are often convened as a way of assembling the needed blend of disciplines. Often, technical specialists with diverse backgrounds are drawn from the participating agencies.

Eventually, either an existing institution is broadened or a new one is created with a specific mandate to ensure the right blend of expertise and staffing. Until a lead agency emerges, however, the group can suffer from the stress of differing charges, responsibilities, and mandates.

The differences and complexities of acid rain control outlined in Chapter 1 suggest that fresh thinking is needed on the role of the State agencies (including State air agencies, State energy offices, power plant siting boards, public utility commissions (PUCs)), representatives from governors' offices and legislatures, utility and industry representatives, environmental groups, consumer advocates, and Federal agencies, including the

EPA, the Federal Energy Regulatory Commission (FERC), and the Department of Energy. For example, in developing a plan to control acid rain, public utility commissions will certainly be involved because most acid deposition control proposals focus on reducing SO_2 emissions from the electric utility industry. Given the *ex parte* nature of most PUCs, an open question is whether the PUCs should wait until the air agency's control plan is complete before assessing the rate impacts, or whether PUC staff should participate in the development and analysis of control options?

A primary role of a lead agency is to resolve problems which may arise where multiple agencies have overlapping or conflicting interests and authorities. An inter-agency agreement or new state legislation may be necessary to clearly identify and empower a lead agency with primary responsibility within a State. Resolution of conflicts between States may require Federal administrative or judicial intervention, or some mechanism for interstate cooperation.

Interstate Coordination

Interstate issues are much more likely to arise under an acid rain control program than under traditional air pollution control efforts because both the nature of the problem and the operation of the primary sources causing the problem are interstate in scope.

Compliance plans developed in one State may be influenced readily by actions in other States: if an out-of-state generating unit that was exporting power is closed, the import "void" must be filled by the power-pool, with a likely consequence that additional generation (and emissions) will be required in the importing state. In such a circumstance, some type of regional or interstate coordination would be necessary to ensure that State compliance plans are compatible and consistent. For highly integrated regions such as New England, regional compliance plans might be a feasible way to ensure compatibility.

Interstate issues are likely whenever a utility serves more than one State, when a utility is a member of an interstate power-pool, when a plant located in one State is owned partially or completely by an out-of-state utility, or if there are a small number of emitters in a region. One or more of these situations occur frequently, and most States face interstate issues to some degree.

CHAPTER 3

IMPLEMENTATION ISSUES

The primary purpose of the STAR Program was to investigate potential implementation issues under a Federally legislated acid rain control program and, in the process, better prepare the States and EPA to carry out such a program. Given that most legislative proposals have focused on emission-based approaches, most of the STAR projects investigated issues that could arise under that type of program. Because of their lower source density and less immediate need to seek reductions, the Western States project (WESTAR) also looked at the implementation issues presented by a pollutant loadings-based program type. Many of the projects, particularly those that focused on control options and costs, would be applicable to all program types.

The following discussion summarizes the major implementation issues identified through the STAR Program and relates them to the *Program Types* and *Concerns* outlined in Chapter 2. Chapter 4 identifies specific State projects that address these issues.

ISSUES LINKED TO IMPLEMENTORS' CONCERNS

In general, the more complex actions and judgments required of the implementor, the more resources will be required to develop, implement, monitor, and enforce a control program. The adequacy of financial, human, and technical resources, and the complexity of administering a program are closely related and may be considered together by examining program elements which can be resource-intensive. The STAR program identified the following as good barometers of resource requirements:

- the type and number of sources to be controlled
- the amount and quality of data necessary to support the control program
- the difficulties of enforcement.

Required Resources and Program Complexity

Selection of the Type and Number of Sources

As indicated in Chapter 1, existing large stationary sources of SO_2 are the primary concern of proposals to control acid rain. Pennsylvania and New York STAR projects used data from emissions inventories to prioritize both the type and number of sources that might be the subject of a control plan. Pennsylvania found that an SO_2 emissions reduction of 30,000 tons per year could be achieved either by controlling one large power plant or, alternatively, by controlling over 100 sources in six different industries.

Candidates for emissions control include stationary (utility, industrial, and commercial), mobile, and area sources. As cogeneration and small non-utility power producers play a larger role in future electricity supply, the distinction between utility and industrial emitters may begin to blur. States with large cogeneration potential may want to consider including nonregulated (electric generating) sources in the potential pool of source categories. Any or all of these emissions source categories could be included within any of the program types.

STAR participants emphasized controlling major stationary source emissions because Federal emissions-based proposals have specified "all fossil-fueled stationary sources," included separate standards for utility and industrial stationary sources, and/or covered only utility sources. Also, regulating a relatively small number of sources is more manageable administratively and technically than controlling numerous area and mobile sources.

In general, the narrower the coverage of a program (e.g., only utility sources) and the fewer compliance options (e.g., only fuel switching and scrubbers allowed), the less complex the program and, probably, the fewer resources required to implement. The broader the coverage of the program (e.g., mobile and all stationary sources) and the more flexibility allowed sources (e.g., trading emissions, using unproven control technologies, etc.), the more difficult and resource-intensive the plan will be to administer. This relationship between resource requirements and program complexity holds for financial, human, and technical resources and overall development and administration of the program.

Administering a source-based control program would be relatively simple once standards are established. The State regulatory agency's role would be confined to identifying the sources to which legislation applies and ensuring that those sources comply with the Federal requirements. Because the State would exercise little discretion, overall administrative cost for a source-based control program would be the smallest of the four program types. In contrast, under an emissions-based program, if States are provided flexibility to determine the type and number of sources to control, regulatory agencies would apportion emissions reductions among sources. States would then defend that apportionment to withstand legal challenge from affected sources and finally ensure that sources comply with the State control plan. Development of a control plan and a defensible

apportionment would significantly increase the administrative complexity and require more resources than a source-based program.

Both pollutant loadings- and effects-based programs contain an unavoidable interstate component (because of atmospheric transport) that creates a significant administrative burden for regulators. This extra burden results from a greatly expanded pool of candidate sources (both number and type), a need for more planning, interstate coordination, more data, more complicated models, and a far greater likelihood that the control plan will be contended. Administrative complexity could increase dramatically because the interstate element would require a level of monitoring and modeling more sophisticated than any yet used to determine which sources (including out-of-state sources) are causing deleterious effects. Apportioning emissions reductions to out-of-state sources goes beyond the experience of most State air agencies.

The Western States STAR project (WESTAR) considered a pollutant loadings-based program because the smaller number of sources in the West might allow for the identification of emitters responsible for exceeding a deposition standard. In the eastern United States, current modeling techniques and source density may make such programs impractical.

In some states, NO_x emissions from mobile sources are major precursor contributors to acid deposition. Particularly in the West, mobile and area sources are important emitters of nitrogen oxides and may need to be included in a control program to secure public support (WESTAR). A 1982 emissions inventory for the New England States indicated that 60% of the NO_x emissions were created by mobile sources, while 60% of the $S0_2$ emissions were from utilities. Emissions controls for new mobile sources are traditionally the domain of the Federal government (an exception is California) and are not a traditional control option available to States. For State regulators, control strategies for mobile sources have been limited to implementing "Inspection and Maintenance" programs, reducing vehicle use, and/or regulating fuel quality. However, States may elect to adopt the tighter California standards as a means of reducing NO_x emissions. The WESTAR project specifically addressed the control of mobile sources as a viable option for a State control agency. Some proposed acid deposition bills recognize the contributions of mobile sources and have provisions for reducing tailpipe NO_x emissions via Federal regulation.

Data Requirements

The type of control program an air agency is asked to implement will influence the complexity of data gathering and analysis. Of the four program types, a source-based control program requires the least data for implementation. Unlike the other control programs, a traditional emissions inventory is not essential for a source-based emissions control program. A source-based program could be implemented with limited data that: identifies the qualifying sources (type, size, and street address); identifies existing controls and current emissions performance; and provides sufficient information to monitor compliance.

Many emission-based legislative proposals specify an emissions "baseline" as well as intermediate determinations of emissions "milestones." To determine baseline emissions, an inventory must be developed of **actual** emissions and not **allowable** emissions (upon which many State permit programs are based). Alabama, Connecticut, Pennsylvania, and the Western States developed or improved inventories of emissions sources as part of their STAR projects. Other States, particularly Michigan, Indiana, and Illinois, investigated procedures to verify emissions estimates with the sources and to reconcile differences when found. The Metropolitan Washington Council of Governments investigated and critiqued different methods of estimating emissions from area sources, which is important in any determination of "baseline" emissions. The Ohio STAR project developed a list of ten general data needs (comprised of numerous subcategories) necessary to provide accurate evaluations of plant-specific control strategies. These efforts provide valuable information about the magnitude of effort and resources required to adequately develop and verify emissions inventories.

With emissions data in hand, State planners could set emissions limits to meet a state-wide average emissions rate or apportion emissions reductions among the sources of emissions. To make reasoned apportionments, States would require source-specific economic and operating data and models such that the relative costs and benefits of various compliance options could be evaluated with respect to each source as well as for the State as a whole. The collection and analysis of this information will require skills not normally found within State air agencies and may require involvement of both air agencies and PUCs. PUC utility cost models can evaluate economic impacts of alternative compliance options, but typically do not include emissions data. Air quality models typically lack the capability to forecast the cost of various compliance options.

Loadings- and effects-based programs require accurate temporal and spatial knowledge of emissions covering interstate regions. Development of a loadings-based program requires greater data gathering and analysis than either source-based or emission-based programs. Regulators will have to develop a sophisticated understanding of the sources and their contributions to acid deposition within a State. To accomplish this, regulators will have to:

- Develop defensible standards for deposition of sulfate and/or nitrate, probably after identifying and understanding sensitive areas within a State.
- Develop an accurate emissions inventory (probably interstate) and determine each State's contributions to violations of the deposition standard.
- Apportion responsibility for emissions reductions to each contributing State or source (probably using mathematical source-receptor models).
- Model the impacts of apportioned emissions reduction.

- Develop monitoring protocols.
- Monitor sensitive areas to determine compliance with the deposition standard.
- Monitor compliance with emissions reduction obligations in every State that contributes to violations.

In addition to all the requirements of a loadings-based program, an effects-based program requires still more data and analysis. Regulators must also identify ecosystems at risk and determine appropriate biologic indicators.

Institutional costs are often overlooked or overshadowed by the costs of control. Depending on the type of control program that a manager is asked to implement, administrative and institutional costs can be considerable. For example, in considering a loading-based program, the Western States estimated it would take hundreds of thousands of dollars and several years to develop and verify models necessary for source-receptor modeling.

Enforcement

Enforcement would be straightforward under a source-based control program. Checking the source to see that specified control equipment was installed and checking performance of that equipment would be typical activities (e.g., stack testing, fuel sampling to verify percent sulfur-in-fuel, tailpipe probes, operating logs, etc.). State control requirements could be incorporated into existing State Implementation Plans (SIPs) to provide EPA with an enforcement mechanism.

An important asset for implementing source-based control programs is further development and wider deployment of continuous emission monitors (CEMs) to minimize the enforcement burden and to further ensure source compliance. Current requirements for CEMs are not uniform: new and existing sources are subject to different compliance requirements; many agencies and sources believe that the current data requirements imposed on the States and sources by EPA are redundant. PEI's investigation concluded that CEMs are rapidly improving and that durability and reliability of CEMs are strongly dependent on proper maintenance. Ironically, facilities with the poorest maintenance record generally have the greatest need for CEMs (poor maintenace is often the cause of emissions excursions). CEM technology is being used successfully abroad to verify continuous compliance. PEI suggests a uniform Federal policy to reduce data handling without compromising quality.

Emission-based programs could present additional enforcement burdens. Any approach that allows emissions trading, leasing, or other more administratively complex approaches (such as managed emissions dispatch) will require a significant additional

commitment of enforcement resources. If reduction requirements are apportioned among emissions sources, the regulatory agency could incorporate reduction commitments into "permits to operate." The agency may be able to use existing staff and regulatory authority to enforce compliance. If an emissions cap is specified, enforcement mechanisms should match the geographic extent of coverage of the control plan (i.e., state-wide enforcement for a state-wide cap; regional enforcement for a regional cap). If an annual or monthly state-wide average emissions rate is specified, some means of checking progress and making "running adjustments" must be incorporated to prevent an excursion at the end of the averaging period. To avoid unpopular forced shut-downs near the end of an averaging period, Massachusetts examined a concept of "Dynamic Emission Management" with a goal of continuously tracking and, if necessary, adjusting the operation of sources to ensure ultimate attainment of annual state-wide average emissions targets.

Enforcement of loading-based or effect-based programs must be viewed from an interstate perspective, which may render them significantly more complex and resource-intensive than either source- or emission-based programs. Emissions contributing to violations of a loadings or effects standard will most likely come from multiple upwind States and may require regulators to develop new enforcement mechanisms. Adequacy of these enforcement mechanisms depends on interstate agreements or provisions in Federal legislation that authorize interstate controls and enforcement mechanisms. The absence of an effective Federal enforcement mechanism could result in the establishment of weak State programs.

Minnesota's loadings-based control program specifies wet sulfate deposition standards and illustrates the difficulties of administering and enforcing multistate emissions reductions necessary to achieve program goals. Minnesota's program, where intrastate sources typically contribute less than 10% of total sulfur deposition at sensitive areas, depends on obtaining enforceable reductions from out-of-state sources. Minnesota air officials estimate that only substantial reductions from out-of-state sources would result in attainment of the deposition standard at Minnesota's most sensitive site. Minnesota's case underscores a need, with this type of program, to develop interstate agreements that would (most likely) need to be ratified by State legislatures and the Federal Congress.

Interaction with Existing Air Programs

The principal acid rain precursors, SO_2 and NO_x, are currently controlled by the ambient program, and further control of these pollutants would have an effect on existing air programs. At STAR workshops, most States indicated that source- and emission-based programs would be relatively easy to integrate with an existing program but that more complex program types may require establishing a separate program infrastructure within and among States.

California's South Coast Air Quality Management District (SCAQMD) conducted a STAR project that looked at extending the Urban Airshed Model beyond its traditional use (of predicting NO_x and ozone) to predict PM_{10}, visibility, and dry acidic deposition as well. This project was specifically designed to extend the use of existing analytic tools to examine

inter-relationships of various control strategies for acidic formation and other existing air quality control programs. This study concluded that inter-relationships are important but that the extended model is not yet ready for regulatory use.

EPA's Region 3 Office (in conjunction with Region 5) is currently investigating the relationship of the existing ambient air program to a potential acid rain control program in the Tri-State region of Pennsylvania, West Virginia, and Ohio. This STAR project will identify: the effect that emissions reductions (made for ambient purposes) may have on acidic deposition; how emissions reductions made to attain the different goals of the ambient program and the goals of an acid rain control program may be reconciled at the source to avoid "double-hitting;" how enforcement of the ambient program might be integrated with an acid rain program; and what role continuous emission monitors might play in the design of both an ambient control plan and an acid rain control plan. This project is on-going.

Contentiousness of Control Program

Equity

Development of acid rain control plans, which is required under all program types except the source-based approach, presents State regulators with a dilemma of how to allocate the costs of control equitably. The basic problems are defining "equity" and determining to what extent equity considerations should influence the design of a control plan. Other issues include whether consideration should be given to prior control efforts and how much consideration should be given to financial impact of control on a given source (i.e., lessening a reduction requirement for a financially troubled source(s)).

Equity has multiple meanings to a diverse group of affected parties: consumers, regulators, sources, those affected by the pollution, ratepayers, fuel suppliers, etc. An examination of how the costs of regulation are shared is central to most definitions. Sources are concerned that Federal or State authorities may force one industry or State to incur a disproportionate share of the cost of reducing emissions.

Likewise, the concept of "cost" is defined differently by affected parties. Expressed narrowly, cost of a control program is simply the aggregate of individual plant control costs. In States with severe acid rain damage, environmental improvement may be "credited" against the cost of control so as to reduce the "net" societal cost of a control program. In States with significant mining of high-sulfur coal, the cost of jobs lost may be added to the cost of the actual control equipment, thus increasing total societal control costs. Economic development agencies predict increased or decreased economic vitality and competitiveness of the State as a result of control actions. Electric utility ratepayers may express "cost" only in terms of individual electric rates, etc. Largely because of these diverse perspectives, the concept of control cost has been historically divisive in the national debate on acid rain control and is likely to be equally divisive at the State level, centering on "cost to whom."

As typically envisioned under emission-based programs, a least-cost compliance plan could be developed by first identifying all emissions sources (utility, industry, area, mobile sources, etc.) and all possible control options at each source. The cost to install each control option at each source would be determined with the corresponding emissions reduction. The State would then rank the combinations of sources and controls from most cost-effective to least cost-effective. A compliance plan might then consist of selecting the most cost-effective options from the ranking until the state's emissions target is met.

Assuming uniform treatment under an emission-based program, industrial sources could incur both the cost of their own emissions controls and a portion of the electric utility controls through higher rates. Alternatively, assigning emissions reductions solely to utilities shifts costs to ratepayers and subsidizes customers of polluting industries.

The WESTAR project concluded that an effective acidic deposition control program in the West would include mobile sources because of their major contribution to total emissions of NO_x and the greater perceived equity. Not regulating mobile sources under an emission-based program would shift the cost of NO_x control entirely onto stationary sources and their customers.

Emissions trading between utilities would allow for more equal distribution of utility costs. However, any direct cost-transfer mechanism that would alter rates would be problematic for the public utility commissions, whose charters (typically) prohibit explicit transfers between utilities. In their STAR project, New Hampshire determined that further control of the Public Service Company of New Hampshire's power plant would be the most cost-effective approach in meeting state-wide sulfur reduction requirements. This project raised the possibility of having smaller emissions sources reimburse the utility for their share of reductions.

In theory, the loadings- and effects-based approaches have scientific equity because emissions reductions would be required only from those sources specifically contributing to violations of a deposition standard or causing damaging effects.

Flexibility

In order to implement a control program that goes forward smoothly, implementors desire the flexibility to determine which sources are to be controlled, with consideration of the economic consequences of those controls on a particular company, industry, locale, and State. Further, implementors desire the flexibility to choose among a number of available strategies and to select the most effective reduction strategy for their State.

Increasing flexibility can benefit the public by keeping costs down. STAR projects support the notion that increased flexibility lowers the cost of compliance to emitters and to their ratepayers and customers. However, lowered cost to emitters may be balanced by increased administrative cost to the control agency. Also, the more decisions and administrative judgments made by the air agency, the greater the likelihood that concerns of equity will dominate and possibly, the more contentious the resulting control program will be.

A source-based control program specifies which sources will be controlled and the level of control to be achieved. Such an approach does not allow the States flexibility in determining which sources are to be controlled and does not take into account the economic consequences that meeting a prescribed standard could have on a particular company, industry, or local economy. Under the source-based approach, the role for states is limited to enforcing source performance. Source-specific standards have the benefit of reducing administrative burdens and encouraging rapid implementation and control.

An emission-based control program may allow States the option of determining specific control actions to be taken at each source or may allow individual emissions sources the flexibility to chose the most environmentally effective or the most cost-effective reduction strategy.

A State could determine that shutting down one source, installing scrubbers at a second, fuel switching at a third, and doing nothing at the rest of State sources is the most cost-effective combination of control options for the State as a whole. As mentioned above, this approach would require the planning group to conduct detailed analyses of the costs and benefits of control options at each source and for all sources in combination. Considerable time and resources would be required. Despite the time and resources invested in developing the plan, it still could be challenged by utilities, industries, or ratepayers that felt they were bearing an unequal burden of total compliance costs.

Whether the State exercises flexibility or allows sources to exercise flexibility, monitoring and enforcement mechanisms will be required. With State allocations, the State would know in advance what compliance actions would be required, and thus, could plan for monitoring these. With sources developing their own mix of controls, States would have less prior knowledge of which compliance actions would be selected, thus raising the possibility of inefficiency and under-utilization of monitoring equipment or enforcement resources. Additionally, States might need specialized tools and/or experience for only one or two sources, which could limit the number of compliance options that States allow sources.

Loadings- and effects-based control programs also provide regulators with the flexibility to select the most environmentally effective or the most cost-effective control strategies. Controls would need to be sought only for those sources causing the loadings or effects standard to be exceeded.

Efficacy

The successful control program will reduce environmental damage from acidic deposition and will prevent future re-occurrence of damage.

A source-based approach has the certainty of establishing a level of performance for controlled sources but the uncertainty of whether those control actions will sufficiently improve the areas damaged by acidic deposition. No direct linkage between effects and source performance is maintained, and some areas may be overprotected while others may

lack sufficient protection. This approach does not limit emissions growth, but it provides regulators with a program that is relatively easy to administer.

An emission-based program provides assurance that expected $S0_2$ and NO_x reductions will be achieved, but like source-based programs, it provides no direct linkage between effects and level of emissions. Effectiveness of emission-based programs is related to the quality of the analysis of various emissions reduction scenarios, regulatory supervision of selected emissions control programs, and enforcement of a potentially diverse group of control techniques.

Loadings- and effects-based control programs would control only those sources that are predicted to cause violations of deposition standards or produce damaging effects. Program effectiveness depends on States pinpointing and adequately controlling out-of-state sources. Theoretically, these programs would require the least intrusive reduction requirements, while producing the greatest environmental benefit. An effects-based program would be administratively complex, but it would provide the potential benefit of targeting and controlling a smaller number of sources.

Multistate Scale

State-based planning is complicated by the interstate nature of the transport of acid rain precursors and the interconnected nature of the electric utility industry.

Nature of Utilities

Almost all utilities belong to one or more power pools that facilitate the economic dispatch of power among member utilities. Some electric utilities have multistate service territories and many are members of utility holding companies that cover large geographic regions. Examples of multistate power-pools include the Pennsylvania, New Jersey, Maryland (PJM) pool and NEPOOL in the New England States. Examples of multistate companies include the American Electric Power Company in the midwest, the Southern Company in the South, and the Tennessee Valley Authority (TVA).

Despite the interstate nature of utility operations, the retail sales of electric utilities (accounting for 75 - 80% of total regulated sales) are regulated on a state-by-state basis. (The Federal Energy Regulatory Commission (FERC) regulates rates for interstate wholesale electric sales, wheeling rates, power-pool arrangements, and interstate electric utility holding companies.) State PUCs must be conscious of interstate coordination and cost-allocation problems. Control of emissions from utility plants may intensify the need for interstate communication and coordination. The following examples illustrate the types of problems that could arise:

- A few generating plants located in one State are partly or wholly owned by other utilities in neighboring States. The State in which the plant is located could allocate a large emissions reduction to the plant owned by out-of-state

utilities or serving customers in neighboring States, thus shifting the costs of compliance to out-of-state ratepayers. Moreover, under existing mandates to provide reliable service at the lowest possible cost, State PUCs could be obligated to shift costs in the manner outlined above.

- One State could select energy conservation as a compliance strategy and actively invest in conservation programs. If the conserving customers are served by a utility that is a member of an interstate power-pool, it is possible that a reduction in emissions (due to conservation) could occur in a neighboring State. Thus, the State buying conservation measures would see no change in its emissions, while another State would benefit from reduced emissions.

- A utility with excess capacity that sells power to utilities in neighboring States could comply by shutting down an old plant, thus reducing the power available for resale. This, in turn, could cause utilities in the neighboring States to operate their own power plants more and increase their emissions. If neighboring States do not accommodate (in their own compliance plans) the anticipated loss of "imported" power, then their own plans could be rendered inadequate.

Interstate issues arising from the electric utility industry would probably be least significant with a source-based program. However, the interstate nature of the electric utility industry becomes a significant factor in the other program types.

Regional Cooperation and Authorities

Implementors are concerned that, to be effective, they must have explicit authority (as well as the practical means and resources) to compel sources to control emissions. Given the interstate transport of acid rain precursors and the nature of the electric utility industry and its existing regulatory structure, it is not possible to eliminate interstate coordination problems such as those described above. Communication among states with related interests might reduce the number and magnitude of conflicts among states. It is doubtful that informal coordination and communication could completely eliminate conflicts between States.

Formal interstate cooperative mechanisms could be established which might include interstate compacts with a designated mediator to resolve significant conflicts. Alternatively, regional planning authorities might provide an informal cooperative mechanism.

Unless some other agency is specified, the *de facto* mediator for interstate conflicts would be the EPA since, under all acid rain legislation proposed to date, the Agency would have responsibility for plan approval. However, EPA may not have the resources to assume this role and does not have extensive experience with utility regulatory issues.

The above options indicate how implementors might respond to current legislative proposals. Alternative solutions require legislative "fixes" to provide explicit mechanisms to foster communication among states and/or to resolve interstate issues and conflicts. Possible options for handling interstate issues include:

- Strengthen the statutory review role of States as part of EPA's plan review and approval process. This would provide a mechanism for States with economic as well as environmental concerns about the compliance plans of neighboring States to express those concerns to the EPA.

- Allow (or require) regional or multistate compliance plans in areas with highly integrated power-pools. While this might reduce the number of conflicts, it would not eliminate them entirely. It would increase the complexity of the compliance plan and the planning process, and correspondingly, increase the amount of time required to develop a plan (see "Timing"). Interstate or regional plans would complicate enforcement, thus highlighting a need for a clear multistate enforcement mechanism.

- Provide a process for neighboring States to establish an interstate commission to review compliance plans of member States. Such a commission could provide a preliminary forum for airing and resolving interstate disputes over implementation and enforcement.

- Place the Federal Energy Regulatory Commission (FERC) in the role of coordinator and adjudicator. FERC currently regulates wholesale exchanges of power and is already familiar with inter-utility and interstate utility regulatory issues. However, FERC does not have experience with air issues, and this would be an additional administrative responsibility. Also, State PUCs might resist casting FERC in the mediator role.

- Explicitly designate EPA as coordinator and adjudicator and provide the agency with the resources needed to carry out the role.

- Develop an arbitration panel, made up of representatives selected from the EPA, FERC, State air agencies, State PUCs, private industry, academia, etc. A possible model for enabling procedures could come from the American Arbitration Association. Authority for such a panel might conflict with States' rights. Different combinations of these options are possible. For example, EPA could be designated the ultimate mediator along with an arbitration panel to provide recommendations to the EPA on specific interstate disputes.

Multiple Interests / Lead Agency

There are a number of State agencies and other interested parties that may want, or need, to be involved in developing a plan for controlling acidic deposition. These include State air agencies, State energy offices, siting boards, coal or natural resource departments, public utility commissions, regional councils of government, representatives from governor's offices and legislatures, utility and industry representatives, environmental groups, and consumer advocates. Public utility commissions (PUCs) will certainly be involved because most acid deposition control proposals focus on the electric utility industry and consequent rate impacts.

Key parties need to be accommodated in the plan development process either formally or informally. If involved formally, roles and responsibilities would need to be clearly defined with sensitivity toward accommodating the diverse goals and constraints of the participants due to different mandates or charters. For example, a charge of air agencies is to meet Federal or State air quality standards, while PUCs are charged with ensuring reliable electric service and financial viability of the utility company while providing electric power at the lowest possible cost to ratepayers. For various reasons, some agencies or groups may find it difficult politically, or impossible legally, to be active participants if other parties are also participants. An example of this is that public utility commissions and air pollution control agencies may be precluded from participating in meetings with utility representatives unless the meetings are announced and open to the public. If involved informally, the views of key parties could be incorporated via a public comment procedure. Failure to involve affected interests could lead to delays in implementing the plan, including protracted public comment, resistance to enabling legislation, and legal challenges to the plan.

A primary role of a lead agency is to resolve conficts which may arise where multiple agencies have overlapping interests and authorities. Resolution of conflicts between agencies could be addressed through the development of interagency agreements which delineate the responsibilities and authority of each participant. If interagency agreements cannot be reached, a higher authority, such as the governor's office or the State legislature, may be required to mediate and settle the dispute.

New State legislation may be necessary to clearly identify and empower a lead agency with authority that matches the geographic scale of the control program. If possible, the lead agency should be the same agency that will plan, implement, monitor, and enforce the control program.

Wisconsin and the Northeast States for Coordinated Air Use Management (NESCAUM) conducted STAR projects that brought together air agencies and PUCs. The Western States Acid Rain Project provided a similar forum for air agencies in ten western states and resulted in the formation of the on-going WESTAR Council to explore options for working together on other air issues of regional interest.

Establishment of interstate agreements is contingent on the willingness of States to negotiate away some autonomy. Elected officials may be unwilling, in the absence of specific Federal reduction targets and sanctions, to force in-state industries to incur substantial costs to benefit citizens of other States.

ISSUES THAT CROSS PROGRAM LINES

Along with the issues linked directly to concerns of implementors discussed in the first section of this chapter, numerous broad additional issues arise from examination of different types of acid rain control programs. These broader issues include:

- **State Goals and Design Philosophies.** To what extent could a State go forward in designing a control program to meet the Federal legislative mandate and, at the same time, achieve local goals of maximizing environmental benefit or minimizing cost?

- **Credible Federal Default.** What effect would back-up assurance of some "control certain" have on the development of State control plans if provided by legislation in advance of plan development?

- **Timing and Schedule Requirements.** What implementation schedule provides sufficient time for States to develop acid rain compliance plans? What can States do in advance to prepare for plan development?

- **Energy Conservation.** What role can energy conservation play in development of compliance plans? How is conservation encouraged or discouraged by compliance plans?

- **Plant Control Options.** How can new Clean Coal Technologies be included and encouraged in compliance plans? Will scrubber suppliers be able to meet demand if legislation is passed, at what price, and with what delay? What price premiums can be expected for low-sulfur fuels?

- **Managed Emissions Dispatch.** How can managed emissions dispatch be used as a control option? Can the existing (State) utility system effectively implement emissions dispatch?

- **Emissions Trading.** What administrative overhead is required of emissions trading? To what extent will trading reduce the cost of compliance? What mechanisms will be necessary to effectively implement emissions trading?

Each of these issues is discussed below.

State Goals and Design Philosophies

In the course of negotiating the scope and scale of the STAR projects, some States became immediately concerned with data and models that might be required to implement a program. One State expressly viewed the role of the State air program as analogous to the role of a plant manager. This view limits the creativity of the air agency to an examination of control equipment that could easily be acquired and installed at facilities throughout the State. Other States started with a much broader question of the purpose and goal of a control program. Given **any** type of control program and **any** portion of a national control burden, a State could go forward designing a control program to meet the letter of the legislative requirement and, at the same time, achieve State goals such as maximizing environmental benefit or minimizing cost to ratepayers or to sources.

Analysts often assume that States, in developing their compliance plans, would strive to control emissions in a manner resulting in lowest total compliance cost for the utilities — without consideration of related economic factors such as environmental benefit or effect on employment and local industries.

Some States have additional goals or constraints that could influence development of a compliance plan. New York State,expressed an interest in developing a State plan that would meet not only Federal requirements but would also provide maximum protection to the acid-sensitive Adirondack region of that State. Alternatively, while fuel switching might be a cost-effective control option for emitters, an overriding State concern might be protection of the local high-sulfur coal mining industry. With sufficiently strong concern for coal miners, a State could limit or prohibit fuel switching as a compliance option. This situation was identified by Kentucky and Pennsylvania, where protection of the local high-sulfur coal mining industry is important and could influence development of compliance plans. Other State-specific goals might include minimizing impact on industry; minimizing rate impacts on "rate-sensitive" industries; or promoting energy conservation or nonfossil energy sources.

Credible Federal Default

Default provides a Federally legislated "back-up" control requirement that would be known at the outset, before States respond to legislation by developing control plans. A default provision would specify some "control certain" in the absense of timely State action. For a default provision to be credible, the Federal government must be able to implement and enforce it without State assistance and with comparable environmental benefit, tolerable economic and social costs, and a certainty of occurrence. Most default proposals preempt the more flexible (and frequently, less-costly) approaches developed by States.

Because of multistate complexities, States are likely to encounter difficulties which might either delay a compliance plan or cause it to be disapproved by EPA. In either event, the interdependence of State plans would necessitate action by all States, either voluntarily or involuntarily via default. Conceivably, a few States could benefit from a default provision because it could relieve the State agency of making difficult allocation choices.

Additionally, any source or group of sources within the State, which believes the default controls to be more favorable than those developed through a State control plan, could delay the State plan and consequently trigger the default provisions.

An important finding of the second national STAR workshop is that States, when faced with a credible Federal default provision, would try to avoid the more restrictive default and would make extra efforts to ensure the timely delivery of an approvable control plan to EPA.

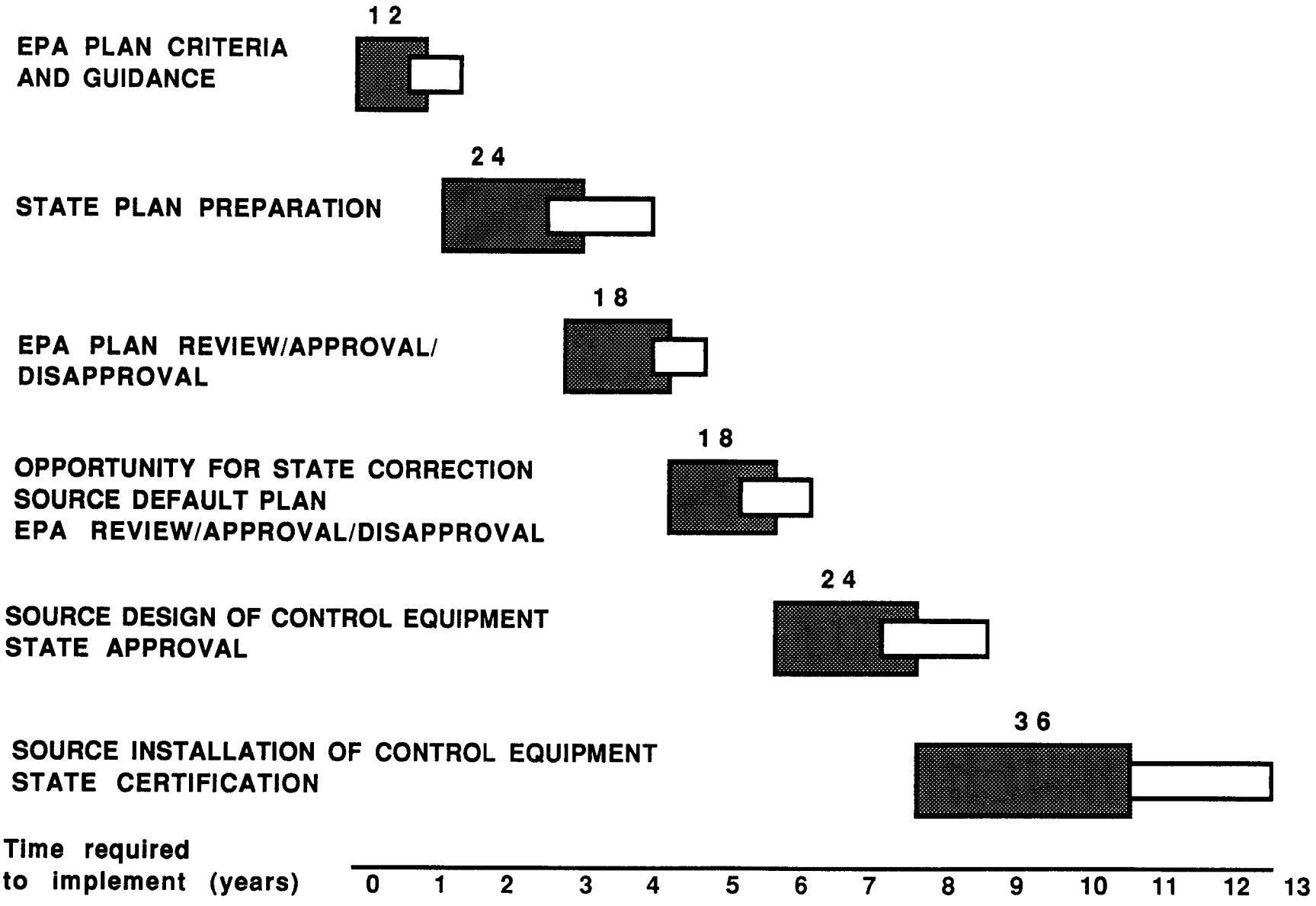
Timing

Results of working groups at the Asheville workshop indicate that some States could require a minimum of 24 months (and preferably 30) to develop control plans. Since that time, several States have indicated that because of the advance planning exercises of the STAR Program, they are now in a better position to develop control plans if required, and that the plan development period might be reduced somewhat — perhaps to 18 to 24 months. On the other hand, results from a January 1989, workshop with State air agencies and public utility commissioners indicate that existing utility regulatory requirements might dictate more time for plan development. A typical State implementation time-line and steps in the plan development and approval process are shown, with corresponding estimates of time required by each step, in Figure 3-1. Results of a Massachusetts STAR project indicate that the longer the implementation time, the greater the prospects of incorporating complex or innovative measures or controls.

Recent legislative proposals are more accommodative of State implementation time-lines. Since January 1988, Bills introduced by Congressmen Cooper (H.R. 5211) and Bonker (H.R. 5622), and the "Mitchell Compromise Proposal" which was not introduced, allowed more time than earlier proposals for State planning (up to 24 months) and final compliance (up to 15 years from enactment) to accommodate deployment of emerging energy technologies.

States continue to question the ability of EPA to approve plans on a timely basis, particularly if EPA were to receive all State plans within a 24-month period. A Wisconsin STAR project with the midwestern PUCs and air agencies supported reducing emissions in two phases to lessen planning bottlenecks and spread the implementation burden over a longer period.

Figure 3 - 1: Implementation Schedule



Depending on the type of control program being implemented, a number of factors (in addition to steps identified in Figure 3-1) may contribute to the length of the planning process:

- development of an emissions inventory and related modeling
- large number of participants in the planning process
- interagency agreements
- consideration and analyses of many control options — some outside the traditional expertise of lead agencies
- consideration of non-air quality goals, such as protecting industry
- coordination with out-of-state agencies where interstate issues are involved
- State legislative and administrative authorization for control strategies
- procedural requirements, notice for review and comment, public hearings, etc.

One Massachusetts STAR project suggested that the time required for acid rain compliance plan development and approval could possibly be shortened by "parallel processing" to provide EPA with intermediate results and allow EPA to interact with State planning groups as the plan was being developed, rather than only after completion. At the beginning of the STAR Program, the concept of "parallel processing" was new, but it is now implemented routinely, particularly in New England.

Energy Conservation

Three primary issues surround energy conservation relative to acid rain control plans: the total magnitude of reductions in electricity demand attributable to implementation of conservation measures; the relationship of these reductions in demand to atmospheric emissions; and whether a State will use conservation techniques prospectively to reduce future emissions, or retrospectively as control devices to reduce current emissions.

Magnitude of Reductions Achievable

Estimates of reductions in demand attributable to energy conservation measures vary greatly, mostly according to assumptions about the penetration of various measures. Considerable effort outside of the STAR Program has been expended developing penetration estimates for consumers, industry, and utilities. Investigators include the Rocky Mountain Institute, TVA, the Bonneville Power Administration (particularly the Hood River Project), DOE, the American Council for an Energy Efficient Economy, the Center for Clean Air Policy, the Princeton Center for Energy and Environmental Studies, Lawrence Berkeley Laboratory, EPRI, the Alliance for Clean Energy, the Environmental and Energy Study Institute, World Resources Institute, the Alliance to Save Energy, a number of university-based groups, and others.

In the STAR program, Massachusetts, NESCAUM, and Wisconsin specifically investigated the role that energy conservation might play in an acid rain control plan. These States and Ohio believe that energy conservation offers potential for reducing emissions and/or the cost of control. Conservation techniques have a short payback period for residential, commercial, and industrial sectors and may also produce savings by eliminating or deferring capital construction of utilities. These States and Tennessee (with TVA) indicate that the attractiveness of conservation to utilities is greatest in regions with unmet demand (e.g., New England) and least in regions with excess generating capacity (e.g., the Midwest) because implementing conservation measures may further increase "excess capacity." Utilities try to minimize excess capacity because such unused capacity produces no return on investment.

However, results of the Tennessee/TVA STAR project indicate that conservation looks particularly attractive when very large generating units (nuclear) are taken off the grid (for routine servicing, due to malfunction, etc.). If excess capacity does not cover shortfall, make-up power must be purchased from neighboring power-pools. In this situation, energy conservation measures would reduce demand for costly purchased power and, consequently, would be more economically attractive to the utility.

Relationship of Emissions to Demand

Maryland and the above STAR projects determined that the relationship between air quality and energy conservation is complex and may be counter-intuitive:

- With economic dispatch, cleaner (more costly) units are usually removed from the grid before the dirtier (and cheaper) units. Consequently, emissions reductions do not always follow demand reductions. Particularly in areas where the electric utility industry is highly integrated between States through regional power-pools (e.g., New England, Pennsylvania, Maryland, and New Jersey), adoption of a conservation program in one State may not provide the intended emissions reductions in that State because of the interstate economic dispatch of utility plants. If each State in a region were to adopt conservation as part of each compliance plan, mutual benefits might occur. These benefits could be fostered by development of regional emissions control requirements and a regional compliance plan.

- Since a utility must support capital investments by selling electricity, implementing conservation measures may cause electric rates to increase so that fixed costs may continue to be paid, particularly in areas with excess generating capacity.

- One utility-sponsored conservation program involving appliance replacement had the unexpected effect of increasing the demand for electricity and, consequently, emissions because older appliances continued in service after being "replaced" with energy-efficient models. This finding underscores the importance of designing and determining the effectiveness of conservation measures.

How States Might Accommodate Conservation in Control Plans

State air agencies may embrace conservation in two fundamentally different ways: either prospectively to reduce future emissions, or retrospectively (as one might use control equipment) to reduce past emissions levels. The ramifications for a State air agency are significant.

If an agency uses conservation programs to reduce future emissions, there is no need for enforcement or for protracted rigorous study of effectiveness or penetration of various conservation measures. States simply make "best-estimates" of the effectiveness of the measures and then turn to the task of implementing and committing their energies to ensuring maximum effectiveness. Since States do not enforce against a projection, the consequences of falling short of expectations are much less than if the performance of conservation measures were being enforced. Discrepancies between *actual* and *projected* emissions may be accommodated by adjusting the mix of conventional emissions controls to supplement any shortfall in the performance of the conservation program. If the conservation program exceeds expectations, conventional controls may not need to be so stringent, or additional "room for growth" may be provided to new or expanding industries. In the Northeast where States are facing a tight supply of electricity, use of conservation may result in postponing new generating capacity but may not result in significant emissions reductions.

If States use conservation measures as conventional controls to reduce existing emissions levels, the need for certainty in the deployment and performance of conservation measures presents a significant obstacle to their adoption by State air agencies. If a source decides to utilize energy conservation measures to control emissions, the air agency will seek reasonable assurance that it can firmly rely on this control. Further, the air agency must provide for sufficient monitoring and tracking of the performance of conservation measures so that defensible enforcement actions may be taken if necessary. In deciding whether to allow a source to implement conservation measures, the air agency must fully evaluate the potential emissions impact. Detailed conservation program data must be developed and electric utility system dispatch models must be run, which require expertise that is not normally available in State air agencies. Public utility commissions and/or State energy agencies might be a source for this type of expertise.

Because of the uncertainties in achieving the projected effect any given set of programs will have on emissions, compliance plans that include conservation may need to include contingency plans that are used if conservation does not achieve the estimated effect in the required time frame. Sources often see contingeny plans as a discouraging extra layer of complexity.

Control Technologies

A wide array of controls is available to sources, ranging from relatively low technology to relatively high technology. Many of the proven methods are familiar to air agencies and new ones are emerging as *clean coal technologies*. A goal of all control technologies is to reduce emissions as effectively as possible. Either an air agency or an emitter may determine which technology best "fits" the required level of control and the unique circumstances at a source. Once chosen, the air agency must ensure the performance and maintenance of a control. Simple fuel switching may be sufficient to achieve small to moderate emissions reductions; scrubbers (or an equivalent) are needed for large reductions. New technologies promise greater control at less cost, but they present the air agency and the source with a question of certainty (i.e., how can performance of an unproven technology be assured?). Control techniques are important under any type of acid rain control program and present implementors with a number of issues, including performance, effectiveness, cost, and reliability.

Conventional Controls

A likely control option for many sources is substituting a lower sulfur content fuel for the current fuel (typically, the substitution of low-sulfur coal, oil, or natural gas for high-sulfur coal). Fuel switching is a clear option at boilers that can easily be converted from one fuel type to another. Some boilers are designed for only specific kinds of fuels, which complicates evaluation of their potential to meet emissions standards by fuel switching.

For an air agency to evaluate the cost-effectiveness of coal switching relative to other control options, an estimate of future low-sulfur coal prices is helpful, but difficult to obtain because the collective response of States to acid rain legislation will certainly influence the price of low-sulfur coal. The extent of this influence cannot be known with certainty. Other uncertainties center on the amount of under-utilized mine and coal processing capacity that is available in the low-sulfur coal industry. Accurate estimates of future coal prices may require expertise not typically found within State air agencies. Sensitivity analyses could be warranted in States anticipating wide-spread switching of fuels to estimate risk.

Many STAR projects investigated control techniques and their costs. Project results were reviewed by the Midwest Research Institute (MRI), and an overview of State efforts was compiled entitled "Review of Methodologies for Estimating Control Costs for Acid Rain Precursors." This report is part of the STAR record and reviews available methods for estimating the cost of SO_2 controls fitted to utility boilers including methods developed by EPA and EPRI. The MRI document is intended to help air agencies identify cost methodologies that may best fit their needs and resources.

The Kentucky STAR project investigated criteria for determining the feasibility of SO_2 and NO_x control technologies. Of fifteen initial criteria, only six were selected as most useful to the State. Kentucky found criteria affecting the selection of SO_2 and NO_x control techniques to be extremely interactive. Specifying a value for one criterion often defines which of the remaining criteria will be most important in determining feasibility of each control technique.

Missouri developed site-specific evaluation criteria for retrofit of control equipment to electric utilities, for fuel switching, and for scrubbing. Criteria include: cost and characteristics of coals; transportation costs; boiler design limitations; effects of control equipment on emissions of other pollutants and on thermal performance; space required for retrofit; sludge disposal; and overall cost-effectiveness.

The Ohio STAR project utilized difficulty factors to determine the feasibility of retrofit of various control technologies to existing facilities. These difficulty factors were developed from cost-estimating guidelines prepared by EPRI and by NAPAP. Ohio used these factors to estimate capital and annual costs of retrofit.

The Florida STAR report provides valuable cost and reliability data on physical coal cleaning, spray-dry FGD, dual alkali FGD, fluidized bed combustion, and limestone injection multi-stage burners (LIMB). Kentucky found LIMB technology to be applicable to 22 of 54 utility boilers examined in their study; Ohio and Missouri also examined LIMB applications but did not develop detailed estimates because they considered the technology "emerging."

Clean Coal Technologies

The Clean Coal Technology Program was created by Congress to assist the development and commercial-scale demonstration of less polluting, more efficient, and less costly control technologies for sources burning high-sulfur coal. Clean Coal Technologies (CCT) include fluidized bed combustion boilers (FBC), advanced coal cleaning, advanced flue gas desulfurization, limestone injection multistage burners (LIMB), and integrated gasification combined cycle (IGCC) turbines.

These new technologies face three types of potential impediments:

- Because technologies are new, estimates of cost and performance are uncertain. Utilities are reluctant to take economic risks with unproven technologies.

- Institutional problems of rate regulation feed utility reluctance to invest in new generating facilities, including CCT.

- Air quality regulations may potentially impede CCT deployment because they may create confusion for the applicant, provide inadequate time for compliance, and/or cause delay in permitting/approval.

Currently, economic, regulatory, and environmental incentives are being considered to address these potential impediments. CCT could play a role under any type of acid rain control program, but States and sources must decide whether CCTs will be incorporated in the range of control options considered for each facility. Depending upon their cost, the status of their commercial demonstration, and compliance deadlines in Federal legislation, States may want to provide for inclusion of CCTs in the control program.

Managed Emissions Dispatch

Managed emissions dispatch operates in a manner similar to economic dispatch except that generating units are brought "on-line" with consideration of their emissions. Currently, the emissions characteristics of generating units are considered only to the extent that the cost of operating control equipment is reflected in the overall cost of operation of each unit (i.e., its rank in the dispatch order).

Best suited to emission-based control programs, managed emissions dispatch could operate under any of the other program types. With loadings- and effects-based programs, this approach could create difficulties, however, since the spatial distribution of pollutants would constantly change as the dispatching system responded to demand. To successfully employ managed emissions dispatch, a State air agency would need to work closely with the central dispatcher to develop a new "sorting" protocol which would fundamentally revise current dispatching practice. The development of the environmental dispatching protocol would likely require expertise and resources not readily available at many air agencies. This approach is not "business as usual" and would require care in implementing to ensure its efficacy. Lack of careful implementation could create repercussions for the State air agency and for the efficient operation of sources. Multiple issues need to be resolved before managed emissions dispatch could be implemented.

A study by the Center for Clean Air Policy, "Acid Rain: Road to a Middleground Solution," indicates substantial compliance cost savings associated with managed emissions dispatch. The subject was investigated by Maryland and Wisconsin STAR projects which concluded that managed emissions dispatch could reduce the cost of compliance in States with excess capacity. However, generating and transmission capacity shortages could limit the use of managed emissions dispatch. Lack of transmission capacity was identified as the limiting factor for the use of this approach in the eastern U.S., specifically mentioned in the NESCAUM STAR project. Wisconsin identified an inverse relationship between managed emissions dispatch and stringency of reduction requirements (i.e., stringent control requirements lessen the value of this approach as a compliance mechanism).

Emissions Trading

If allowed by legislation, emissions trading could operate under any of the four program types but would be best suited for emission-based programs. Theoretically, emissions trading provides flexibility and potential cost reductions, while having minimal impact on the achievement of the environmental objectives of a regional pollution problem. Since pollution control costs vary from source to source, trading would allow sources that could reduce emissions inexpensively to sell or lease additional emissions reductions to sources that find reaching even their required reductions too costly. This would allow a State to achieve lower-cost compliance.

Although a few legislative proposals suggested controlling one pollutant in order to get credit for controlling another (i.e., trading NO_x for SO_2), this approach has not been considered recently because SO_2 is linked to adverse environmental effects from acidic deposition while the contribution of NO_x remains vague. Any consideration of inter-pollutant trading must await a better understanding of the role of NO_x in acidic deposition and its cross-relationship to ozone formation.

North Carolina and Massachusetts STAR projects found that, in general, the broader the trading, the greater the cost savings, but the greater the administrative and enforcement burden. The narrowest trading would be between units at the same facility. Broader trading could occur among sources owned by the same company and located in the same State. These trades would be the easiest to enforce because the required reductions for each source could be aggregated into a total facility-wide or company-wide reduction. Trading could be broadened to allow trading between sources owned by different companies but still located in the same State. The broadest trading envisioned would allow trading between sources located in different States and either owned by the same company or by different companies. Generally, trading is assumed to take place between utility sources, although trading between utility and industry sources could occur.

Ideally, emissions trading could allow a State to achieve the least-cost compliance strategy. However, there are barriers to achieving this ideal situation; administrative and enforcement needs would be considerable. Additionally, efficient emissions trading requires participation of enough buyers and sellers; emissions sources may need incentives to participate; and utilities might be reluctant to participate due to uncertainty about how their PUC might treat trading revenues and costs.

The difficulties of administration and enforcement are important to air agencies: An example concerns two sources, one of which (the selling source) installs a scrubber. If, after the trade, the scrubber operates only at partial capacity, against which source does the State enforce (i.e., which source has first claim to the reduced emissions)? If the scrubber or the scrubbed plant is shut down for extended maintenance, must both sources cease operations, or just the controlling source? These enforcement questions become more complicated as more players become involved. Would the State allow any selling source to sell credits to more than one buyer, and a buying source to purchase credits from more than one seller?

Trading between States amplifies administrative and enforcement problems. Two (or more) air agencies and corresponding public utility commissions would be involved, and enforcement issues may need to be allocated between States. While the Florida and Maryland STAR projects identified cost benefits attributable to interstate trading, STAR projects generally concluded that interstate trading would be difficult to implement and enforce. The Massachusetts STAR project identified discrepancies between State rules and regulations that would have to be reconciled before interstate trading could take place. One of the NESCAUM projects also examined interstate trading and reached similar conclusions. A study by the Center for Clean Air Policy ("Acid Rain: Road to a Middle-

ground Solution," July 1987) indicates potential for considerable compliance cost savings from trades involving units owned by American Electric Power (AEP) subsidiaries located in five States.

In a similar study, the Tennessee STAR project, in concert with TVA, looked at benefits and administrative costs of implementing an emissions "cap" at the plant-level, the State-level, and at an interstate system (company) level. Tennessee concluded that a system cap is the most cost-effective of the three and would reduce cost of compliance by up to 50% over the plant-level cap. However, the study indicates that this scale of implementation poses the additional requirement of cooperation among States. While all three caps improve overall air quality, the plant cap produced the greatest overall improvement.

A number of remedies were proposed by States to overcome some of the barriers to implementation discribed above. Leases of emissions credits for a fixed period of time might encourage otherwise reluctant sources to participate because sellers would be able to reclaim the emissions credits at a future time when and if the source needed them for growth. Public utility commissions could address these concerns directly through development of sample contracts and advance hearings on trading costs.

CHAPTER 4

SUMMARIES OF STAR PROJECTS

Between 1984 and 1988, EPA funded 47 State Acid Rain projects. Two projects were cancelled and most of the remaining 45 projects were completed with final reports prepared. To prepare this final report, summaries of all projects and final reports were reviewed. Figure 4-1 lists STAR projects that have summaries available and indicates the focus of each project. Some projects are missing from the list because neither a summary nor a final report were available. Missouri and WESTAR provided a single summary for more than one project.

A set of "key words" was developed to identify the focus of each state STAR project. Key words were grouped into seven broad categories:

- Control Approaches
  - Rate vs. Target
  - NO_x Reduction
- Basic Information Requirements
  - Emissions Inventory
  - Deposition Modeling
  - Control/Cost Modeling
- Control Technologies
  - FGD Scrubbers
  - New Technologies
  - Coal Cleaning
- Other Compliance Strategies
  - Fuel Switching
  - Energy Conservation
  - Emissions Trading
  - Environmental Dispatch
  - Life Extension
  - Plant Retirement

- Compliance Planning
  - Planning Criteria
  - Planning Constraints
  - Regional Approach
  - Utility Commissions
  - Public Perceptions

- Industrial Controls

- Monitoring and Enforcement

Most of the STAR projects investigated more than one issue. Popular issues investigated by the STAR projects include: planning criteria (17 projects), use of flue gas desulfurization (FGD/scrubbers) (12 projects), use of fuel switching (15 projects), and development or validation of emissions inventories (13 projects).

The STAR projects summarized in alphabetical order are based in part on summaries prepared by the states or EPA and augmented by independent readings of final reports by ERM-Rocky Mountain. Table 4-2 provides a complete list of STAR project reports.

Appendix A provides brief (1- to 4-page) summaries of the individual STAR projects.

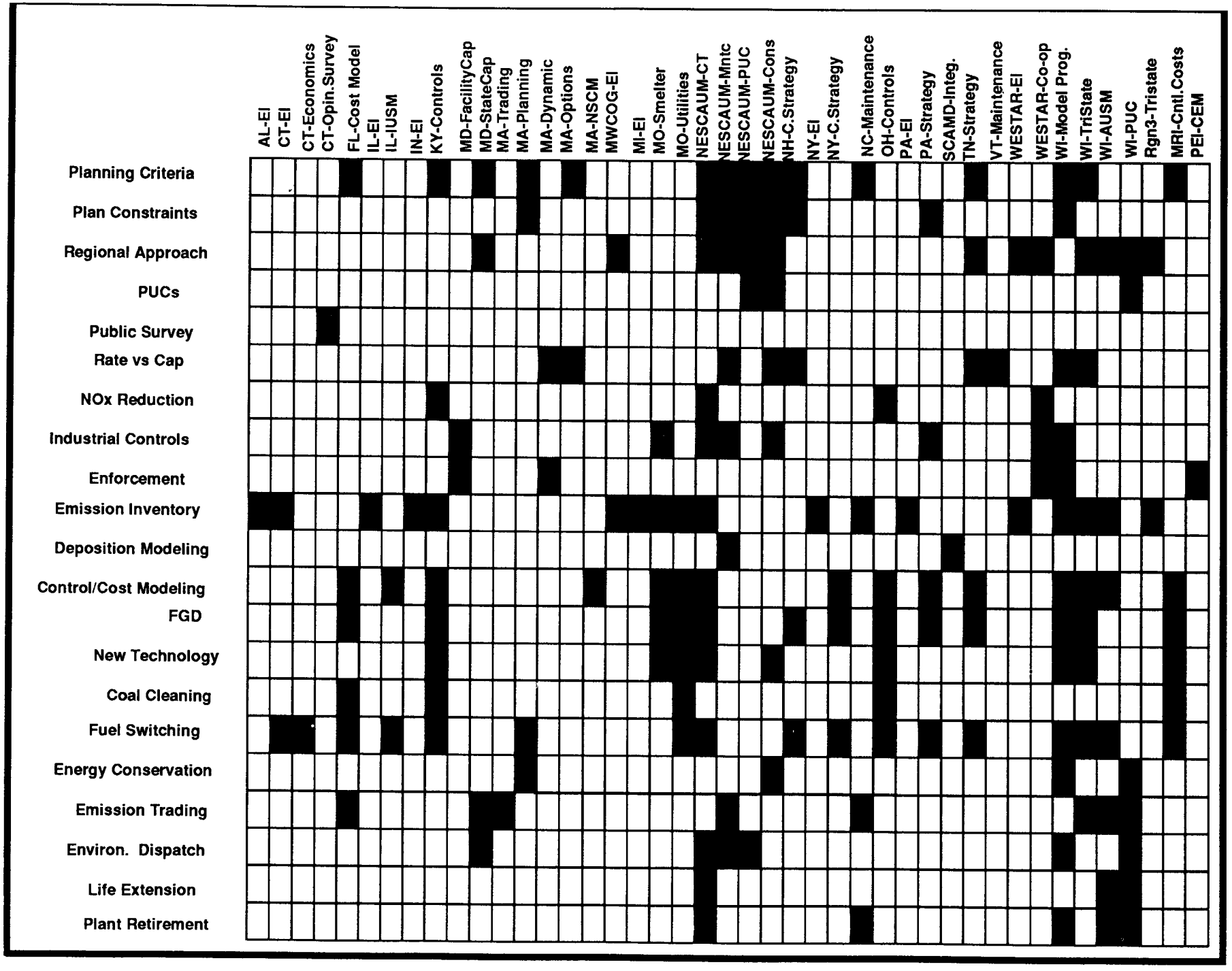


Figure 4.1 Subjects of STAR Projects

TABLE 4.2 -- Reports of STAR Projects

Alabama	Alabama Department of Environmental Management, Sulfur Dioxide and Nitrogen Oxide Emissions from Industrial and Utility Sources in Alabama from 1980 to 1985, July, 1986.
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Connecticut	Chmura, Thomas J. for the Connecticut Department of Environmental Protection, A Survey of Connecticut Residential Electricity Customers' Perceptions of Acid Rain Issues, March, 1987.
Connecticut	Chmura, Thomas J. and Laforte, Joseph D., for the Connecticut Department of Environmental Protection, Projected Sulfur Oxide Emissions in Connecticut--Status Quo and Revision to 0.5% Sulfur Content, July, 1987.
Florida	Florida Department of Environmental Regulation, Acid Rain Control: A Cost Estimation Model for Florida, December,1987.
Illinois	Illinois Environmental Protection Agency, The Illinois Environmental Protection Agency STAR Data Base Management System User's Guide, February, 1988.
Illinois	Illinois Environmental Protection Agency, Report on the Methods, Procedures, and Problem Resolution for Compiling the Non-Utility Sulfur Dioxide Emissions Data Base for the Illinois Environmental Protection Agency STAR Project, November, 1987.
Indiana	Indiana Department of Environmental Management, Emission Inventory Verification, February 26, 1988.
Kentucky	Kentucky Department for Environmental Protection, Kentucky State Acid Rain (STAR) Project, December, 1987.
Maryland	Maryland Department of Economic and Community Development and BEST Consulting, (Draft) Statewide Caps on Sulfur Emissions in Maryland, July 24, 1986.
Maryland	ERT for the State of Maryland, Description of the Emissions "Cap" at Westvaco Corporation's Luke Mill (Luke, Maryland) and Discussion of Possible Extension of this Emission Control Approach to Other Major Industrial Sources, August, 1986.

Table 4.2 (continued)

Massachusetts	Massachusetts Department of Environmental Quality Engineering, A Methodology for Evaluating Acid Rain Control Strategies -- A Massachusetts Case Study, July, 1988.
Massachusetts	Massachusetts Department of Environmental Quality Engineering, Development and Testing of a Planning Approach to Acid Deposition Control, February, 1987.
Massachusetts	Massachusetts Department of Environmental Quality Engineering, Dynamic Emissions Management for Acid Deposition Control, June, 1987.
Massachusetts	Massachusetts Department of Environmental Quality Engineering, Emissions Trading Within Acid Deposition Control, October, 1986.
Massachusetts	Massachusetts Department of Environmental Quality Engineering, Evaluation of Options for Acid Deposition Control Program Regulations, April, 1988.
MWCOG	Metropolitan Washington Council of Governments, Estimation of 1985 Area and Mobile Source Emissions of Sulfur Dioxide and Oxides of Nitrogen in the Washington, D.C., Metropolitan Area, March,1988.
Michigan	Michigan Department of Natural Resources, Emission Inventory Verification Procedures, March, 1988.
Missouri	Energy Ventures Analysis, Inc. for the Missouri Division of Environmental Quality, Cost-Effectiveness Analyses of SO_2 Reduction Alternatives at 13 Selected Missouri Utility Powerplants, July, 1986.
Missouri	Energy Ventures Analysis, Inc. for the Missouri Division of Environmental Quality, Cost-Effectiveness Analyses of SO_2 Reduction Alternatives at 3 Missouri Primary Lead Smelters, August, 1986.
NESCAUM	Northeast States for Coordinated Air Use Management, Appropriate Emission Control Techniques for the New England States, December, 1986.
NESCAUM	Northeast States for Coordinated Air Use Management, Maintaining State Emission Levels, December, 1986.
NESCAUM	Northeast States for Coordinated Air Use Management, Air Quality and Energy Conservation: Cutting the Cost of Clean Air, September, 1988.

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NESCAUM	Northeast States for Coordinated Air Use Management, Education and Communication Between the New England Air Quality Control Divisions and Public Utility Commissions, August, 1987.
New Hampshire	GCA Corporation for the State of New Hampshire, (Draft-Final) Development of a Methodology to Evaluate Costs and Impacts of Several Acid Rain Control Strategies in New Hampshire.
New York	New York State Department of Environmental Conservation, Evaluation of Sulfur Dioxide Emissions Reduction Strategies from New York Utilities - A Guide for Other States, January 29, 1988.
New York	New York State Department of Environmental Conservation, Procedures for Estimating Statewide Sulfur Dioxide and Nitrogen Dioxide Air Emissions, September, 1986.
North Carolina	North Carolina Department of Natural Resources and Community Development, Alternative Emission Offset Programs, September, 1987.
Ohio	PEI Associates, Inc. for Ohio Environmental Protection Agency, Estimation of the Cost of Reducing Sulfur Dioxide Emissions in Ohio (Volume I), October, 1987.
Pennsylvania	E.H. Pechan and Associates, Inc., for the Commonwealth of Pennsylvania, Pennsylvania STAR Project--Phase I: Data Base Refinement, July, 1987.
Pennsylvania	E.H. Pechan and Associates, Inc., Pennsylvania STAR Project--Phase II: Strategy Development, July, 1988.
SCAQMD	South Coast Air Quality Management District, Development of a Photochemical Air Quality Model with Extensions to Calculate Aerosol Dynamics and Visibility (Project Summary), September 8, 1987.
Tennessee	Tennessee Valley Authority, Tennessee State Acid Rain Project: A Study of SO_2 Emission Reduction Strategies for a Multistate Utility, November, 1985.
Tennessee	Midwest Research Institute, Tennessee Acid Rain Project, March 27, 1987.

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Vermont	Vermont Air Pollution Control Division, Sensitivity to Alternative Maintenance Plan Provisions in a State with Low Emissions, March, 1987.
WESTAR	ERM for WESTAR, Analysis of Options for the Implementation of an Acid Deposition Program in the Western U.S., March 31, 1988.
WESTAR I	Gaia Associates for the Western Governors' Association, (Draft) An Assessment of Existing Regulatory Mechanisms for Controlling Precursors of Acid Deposition in 12 Western States. Phase I - Task D, September, 1986.
WESTAR	PEI Associates, Inc. and E.H. Pechan and Associates for Western Governors' Association, (Draft) Western States Acid Deposition Project - Phase II: Technical Feasibility and Cost of Obtaining Further Reduction in SO_2 and NO_x Emissions from Existing and New Sources. Volumes I and II, October, 1987.
Wisconsin	Wisconsin Department of Natural Resources and Wisconsin Public Service Commission, The Potential Role of Public Service Commissions (PSC's) in Implementing National Acid Rain Control Policies.
Wisconsin	Wisconsin Public Service Commission, STAR Report, October, 1987.
MRI, Inc.	Midwest Research Institute, Inc., Review of Methodologies for Estimating Control Costs for Acid Rain Precursors (Final Report), September 30, 1987.
PEI, Inc.	PEI, Inc., Issues Associated with the Expanded Use of CEM's for Potential Acid Rain Emissions Reduction Initiatives, April, 1988.

CHAPTER 5

USEFULNESS OF THE STAR PROGRAM

This chapter examines the EPA STAR Program and highlights management approaches that were used because of the special nonregulatory nature of the effort. A third party solicited reactions to the program from the States, and the results are presented in this chapter.

THE CHALLENGE

Unlike most pollution control programs that are set in place hurriedly in response to legislative deadlines, the STAR Program was established with only the threat of legislation. The absence of actual control legislation allowed time for an examination of issues that could potentially confront program administrators if they were asked to implement a major control program. Recognizing the differences between acid rain and traditional pollutants, the EPA sought to discover how these differences (see Chapter 1) might affect the structure of control programs and how the States might implement potential Federal legislation in this area.

The STAR Program was unique because it examined implementation issues **before** legislation passed, and it engaged the parties likely to have primary responsibility for carrying out a national control effort, the State air agencies. Without the force of regulation, EPA's challenge was to constructively engage the States, while recognizing the fullness of on-going regulatory activities that demand States' attention.

The STAR Program went forward with a commitment to remain "policy-neutral" by taking no position in favor of or opposing acid rain controls. Under that broad commitment, the STAR Program was further commited to: technology transfer (sharing findings) among the States; an emphasis on clear and concise reporting; and a belief that positive, useful information could be gleaned from failed attempts and unsuccessful investigations, as well as from approaches that proved successful. States were encouraged to experiment and to expand the boundaries of traditional responses and to think about how the problems that might be presented by a regional pollutant like acid rain (and solutions to those problems) might be different from the familiar ambient program.

THE TOOLS

To facilitate interchange among States and their Federal counterparts, new and expanded management approaches were employed from the beginning of the STAR Program to engage a national network of air pollution professionals at all levels of government. These approaches were designed to enhance communication with the States as well as to provide information on the status of all projects. Interim progress and final reports were utilized alongside such additional approaches as national workshops, informational memoranda, a computerized public-access progress tracking bulletin board, frequently updated lists of State and Federal STAR contacts, enhanced coordination with the EPA Regional Offices, and increased communication with STAPPA/ALAPCO (State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials).

To determine State opinion of the usefulness and overall management of the STAR Program, EPA retained a third-party consulting firm (ERM-Rocky Mountain) to solicit views from the States. ERM formed a program review team to coordinate the effort and started by reviewing management documents produced by the STAR Program. A meeting to obtain State comment was held on May 18, 1988 in Washington, D.C. in conjunction with STAPPA/ALAPCO and was followed by individual interviews with State representatives. Finally, a survey initiated by STAR management was sent to the States (State program directors and key project staff) through STAPPA/ALAPCO in November 1988, to determine their opinions of the program and EPA management effort. A copy of the State survey and results are presented in Appendix B.

THE OPINION OF THE STATES

Management Approaches

Increased communication with STAPPA/ALAPCO and the national workshops were regarded by States as the most important and successful of the EPA management tools, and these are discussed separately. Wisconsin believed the informational memoranda, called STAR UPDATES, were primarily important to air pollution control officials, staff, and interested parties **not** actively involved in the STAR Program. For those fully involved in the STAR Program, Wisconsin preferred personal discussion with EPA Headquarters staff for timely and relevant information. Other States concurred that the informational memoranda were more important for individuals less directly involved.

Likewise, States suggested that STAR-TRAK, the computerized EPA management tool (of project status, STAR contacts, and deadlines) served as a valuable public-access communications vehicle on project status, but it was useful primarily for administrators and others not directly involved. STAR-TRAK was believed to be most important for monitoring project status and administering grant commitments. Some States believed STAR-TRAK to be an important tool for the Regions but not for the States. STAR-TRAK appears to have served a useful overall function by providing any interested party with detailed project and fiscal status.

Some participants indicated a general dislike of all management tools like STAR UPDATE and STAR-TRAK, but the majority believed that they were useful for specific audiences and that they can effectively support efforts like the STAR program.

Role of the EPA Regional Offices

Although the EPA Headquarters STAR staff believed that several of the Regional Offices played a constructive role with the States during the STAR Program (particularly Regions 1, 4, and 5), the States indicated that the Regional role was not significant for most project activities and was limited (except for Region 1) to providing grant money and periodically monitoring expenditures. This difference of perceived role for the Regions may indicate a need to better define future roles for voluntary programs developed by the Agency. For regulatory activities, the Regional role appears to be well-defined.

Role of STAPPA/ALAPCO

EPA project managers sought involvement of STAPPA/ALAPCO from the beginning of the STAR Program. While the Agency as a whole has made tremendous strides in recent years in their understanding of and involvement with the National Governors' Association and other Executive Branch Organizations, the STAR Program managers, from the beginning, utilized STAPPA/ALAPCO to help develop the direction of the STAR Program, select State projects, and provide on-going communication with the States.

Early in the Program, EPA Headquarters and Regional Office staff developed an initial list of "Potential Acid Rain Control Program Implementation Issues," and shared the product with the States through STAPPA/ALAPCO's Acid Rain Implementation Task Force. Later, STAPPA/ ALAPCO provided suggestions to EPA in the development of evaluation criteria by which projects were selected for funding. Following EPA's selection, STAPPA/ALAPCO's Task Force reviewed and concurred with EPA's ranking of the proposals. EPA initiated awards for 13 projects and agreed to defer the remainder. In December 1984, during the semi-annual meeting of STAPPA/ALAPCO, the membership endorsed the Task Force recommendation to concur with EPA's ranking of the remaining proposals. As a result of this initial interaction, and through continuing interest, STAPPA/ ALAPCO remains instrumental in assessing the importance of State studies of emerging issues.

STAPPA/ALAPCO's Task Force proved to be a key sounding board for EPA staff ideas and facilitated communications with the States. STAPPA/ALAPCO staff participated in the STAR workshops and helped organize a meeting with State and Local Air Officials and the STAR Program staff on May 18, 1988. This meeting led to the State survey (Appendix B) and follow-up interviews with States to solicit their views on the management of the STAR Program.

Coordination with STAPPA/ALAPCO demonstrated benefits and proved to be a very effective way to increase dialogue with States and to provide increased project "networking." This approach can work for regulatory program activities as well as for voluntary efforts like STAR.

National STAR Workshops

Based on State interviews, the single most effective program management tool was EPA's use of workshops. Both national workshops emphasized involvement of State project staff and provided an important forum for one-on-one contacts between STAR project participants, EPA staff, and other interested parties.

The first workshop was held in Pittsburgh, Pennsylvania on November 19-21, 1985. This workshop featured an overview of Federal legislative proposals to control acid rain, addressed the background of the STAR Program, and identified attributes of a successful project. Even though many projects were underway, none had yet produced significant findings and most projects were still maleable and could incorporate suggestions from the workshop. In addition, the meeting provided an excellent opportunity for participants to discuss current project efforts and to exchange ideas on future activities. "Proceedings of the First STAR Workshop, Pittsburgh, Pennsylvania, November 19-21, 1985," documents this workshop.

The second STAR workshop, held in Asheville, North Carolina on October 20-23, 1986, was coordinated by the States of North Carolina and Wisconsin. While many participants believed the Pittsburgh workshop established important contacts, they believed the Asheville workshop provided valuable information on anticipated project results. The clear focus of this workshop was sharing program results to date, although the status of Federal research and legislative proposals was reported as well. By the fall of 1986, specific issues and ideas were sufficiently developed that detailed substantive discussions could occur.

With this in mind, the second workshop was carefully structured to maximize its usefulness to participants, individual projects, and to the STAR Program. As background, an evening session provided an opportunity to review judicial, legislative, and administrative events of the preceding year relating to the acid rain issue. The first full day of the workshop was dedicated to reviewing current and anticipated findings of the individual STAR projects. A second day was designed to interactively apply the collective knowledge and experience of the participants to a mock program implementation exercise using small workgroups. These workgroups were carefully chosen to ensure that membership included a representative cross-section of States (i.e., both "sending" and "receiving" States; industrial and non-industrial; geographically diverse; etc.). Four workgroups defined the actions States would take and the schedule they would follow in response to the hypothetical passage of acid rain control legislation. With two groups each on two different legislative approaches, it was possible to develop independent responses to the same legislation, as well as to compare responses to different legislative approaches.

The workshop also provided an opportunity to brief participants on the aquatics and forest research programs and included a day-long tour of current research sites on Mount Mitchell to examine forest damage.

Largely because of its structure, the Asheville workshop produced useful insights to State implementation. Results of the working groups indicate:

- recognition of the diversity that exists among States and that State responses to a control program will vary according to the needs of each State.
- awareness of many interests within each State and a need for a team approach on plan development.
- that at least 24 to 30 months would be necessary for plan development and for adequate resolution of conflicting interests in the more complex States, based on an assumption that clear EPA approval criteria would be known at the outset.*
- that a credible default provision would make a significant difference in how States might respond to a national control program.
- that energy conservation and efficiency measures have potential to reduce emissions.
- that States prefer maximum flexibility in developing a plan and in making allocation decisions, although this preference was not unanimous.
- recognition of the interstate nature of utility operations and its potential to complicate State control plannning.

Participants were wary of the administrative burden of emissions trading; believed that the concept of source verification of emissions data was sound (and long overdue); recognized that too much data was frequently collected without consideration of the specific data elements that are actually needed; were skeptical of the usefulness of economic/ emissions models for plan development; and identified key problems with both the "total emissions" and "emissions rate" approaches to a control plan. "Proceedings of the Second STAR Workshop, Asheville, North Carolina, October, 1986" are available from EPA.

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* Footnote: Although, in the two years since this workshop, some believe that the STAR Program, and similar strategy development done by States, may have shortened this time requirement.

With the exception of New Hampshire, States indicated that the STAR workshops were the most successful part of the STAR Program and that they provided excellent forums to initiate and continue peer contacts, to exchange specific ideas on projects, and to direct and broaden program understanding and the base of participation in the discussions. Individual participants indicated that the workshops, especially the second workshop, surpassed expectations. The STAR workshop approach, with its generous involvement of the States and problem-solving atmosphere, created a different kind of interactive relationship than frequently found with previous responses to Federal-State regulatory issues. Several participants indicated a sense of *camaraderie* and *esprit de corps* among fellow STAR participants by the end of the Program.

Summary of STAR Management

The STAR Program provided an opportunity for EPA to develop and use multiple program management tools beyond those traditionally used by the Agency in its regulatory programs. States were asked to assess these tools. In general, States were complimentary of the STAR management approach, particularly of the frequent consultation with States and STAPPA/ALAPCO during development and operation of the program. This interactive approach generated a level of trust in the process not always found in State/EPA relationships. Newsletters and other written communications were important, but they were useful mostly to individuals who were interested but only peripherally involved. Workshops structured to involve State participants were the most impressive of EPA's management efforts.

Most States believed that the workshops were very successful and provided the best possible mechanism to interact with State peers and to discuss and "brainstorm" implementation ideas. The Asheville workshop was considered by the States to be especially effective. By the time of this workshop, State projects were showing results which allowed substantive discussion. States also appreciated the implementation planning exercise of this second workshop. Use of workshops, designed with a significant role for the participating States, is the single most important transferrable element from the STAR Program. Based on State comment, the project review team recommends that workshops structured along the lines of those employed in the STAR Program be considered for use in all Agency programs.

The significant criticism of the management approach of the STAR Program was the unusual level of freedom provided participants to explore ideas and new approaches. Some States believed that too much flexibility was provided to the State participants and that follow-through was insufficient to achieve timely completion of all State projects. This comment is most unusual in State/EPA relationships, and the project review team believes it reflects a deliberate EPA effort to allow participants "room to think," an approach made possible by the nonregulatory nature of the STAR Program.

States believe management of the STAR Program by EPA Headquarter's staff was constructive and provided flexibility to States in the completion of their STAR projects. Both States and EPA believe that the Agency can benefit from the STAR experience in future relationships with States and that the Agency should be alert to potential new program areas early enough so that exercises like STAR may be utilized.