

NARSTO-1997-1

NARSTO Strategic Execution Plan

Part 1: Introduction and Overview

March 1997

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1

NARSTO OVERVIEW

1.1 NARSTO Mission

The North American Research Strategy for Tropospheric Ozone (NARSTO) program is a public/private partnership, whose membership spans government, the utilities, industry, and academia throughout Mexico, the United States, and Canada. Its primary mission is to coordinate and enhance policy-relevant scientific research and assessment of tropospheric ozone behavior, with the central programmatic goal of determining workable, efficient, and effective strategies for local and regional ozone management. In accomplishing this goal, NARSTO is charged with establishing and maintaining effective communication channels between its scientific effort and its client community of planners, decision-makers, stakeholders, and strategic analysts. It is also charged with providing a cross-organization planning process, which determines the most effective strategies for scientific investigation. NARSTO coordinates the allocation of financial resources to implement these strategies, and monitors progress of its effort toward fulfillment of its programmatic goal. A listing of current NARSTO member organizations and an aggregated inventory of their current ozone research activities, appears in Appendix 1-A.

1.2 Historical Summary

The origins of the NARSTO program stem from a 1991 report, entitled *Rethinking the Ozone Problem in Urban and Regional Air Pollution* (National Research Council, 1991). In addition to providing a technical description of the chemistry and meteorology associated with tropospheric ozone formation, this report presents a historical overview of North American tropospheric ozone trends and control measures since the 1963 enactment of the original United States Clean Air Act. It notes that despite major regulatory programs over the past 20 years, efforts to attain North American ozone standards have been only marginally successful throughout major portions for the continent. Multiple factors contribute to this slow progress in resolving the ozone issue. Such factors include uncertainties in characterizing local meteorological influences, reaction chemistry, deposition, and the contribution of stratospheric ozone, as well as our present inability to quantify anthropic emissions in a satisfactory manner. These combine with the uncertain but often important role of naturally emitted pollutants and the propensity of ozone and its nitrogen-oxide and organic-compound precursors to travel several hundreds of kilometers in the atmosphere prior to their removal by chemical reaction or deposition. It is noteworthy within this context that only one of these factors — anthropic emissions — is subject to control under any practical management strategy; but the effective and wise design of such control depends heavily on the joint behavior of the others.

All of these effects vary considerably with geographical location, and all complicate regulatory considerations appreciably. The above-noted long-range transport feature limits the efficacy of local emission-control strategies in many regions of the continent, because large quantities of ozone and its precursors are likely to be introduced from remote upwind sources that lie beyond the local control domain in question. This situation is particularly troublesome in the United States owing to interstate transport, which is essentially ignored by the basic state-level regulatory strategy imposed under the U.S. Clean Air Act. Natural emissions are problematic both because they are extremely difficult to quantify and because several elements of their atmospheric chemistry are not well understood at the present time.

Reflecting on these features and on the number of ozone studies that have been conducted on a somewhat mutually uncoordinated basis, the National Research Council report concluded that “Progress toward reducing [tropospheric urban and regional] ozone concentrations . . . has been severely hampered by the lack of a coordinated national program directed at elucidating the chemical, physical, and meteorological processes that control ozone formation and concentrations over North America.” The NARSTO program is a direct response to this NRC conclusion.

The NARSTO concept was initiated through a series of technical workshops conducted with joint efforts of the National Oceanic and Atmospheric Administration (NOAA), the Electric Power Research Institute (EPRI), the California Air Resources Board (ARB), and the Environmental Protection Agency (EPA). These workshops aimed at producing a general NARSTO strategy document, and were culminated in a 1994 Boulder, Colorado meeting, which set the basis for the *NARSTO Research Strategy and Charter* (NARSTO 1994), a formal report published in November of 1994. In addition to setting forth the functional structure of the NARSTO organization, this report documents the program’s basic rationale, itemizes key science and policy questions to be addressed by the program, and summarizes the scientific activities required for fulfillment of the NARSTO goals. Figure 1-1 outlines the NARSTO functional structure; science and policy questions of the *NARSTO Research Strategy and Charter* are summarized in Inset 1-1.

NARSTO held a charter-signing ceremony at the White House on February 13, 1995, and since that time the program has moved rapidly to activate the organizational structure of Figure 1-1. One of the more important and pivotal elements of this 1995 effort was a July meeting of NARSTO’s Science and Resource Planning Group, which established a formal research-selection protocol as well as many of the guidelines for this Strategic Execution Plan. Subsequently, NARSTO conducted a general meeting (San Antonio, November 1995) to finalize the activation process and to set a consensus basis for its emerging action plan. More recently, NARSTO’s Executive Assembly held a second White House meeting to further forge the operational process. Key results of these formative efforts are summarized in the sections immediately following.

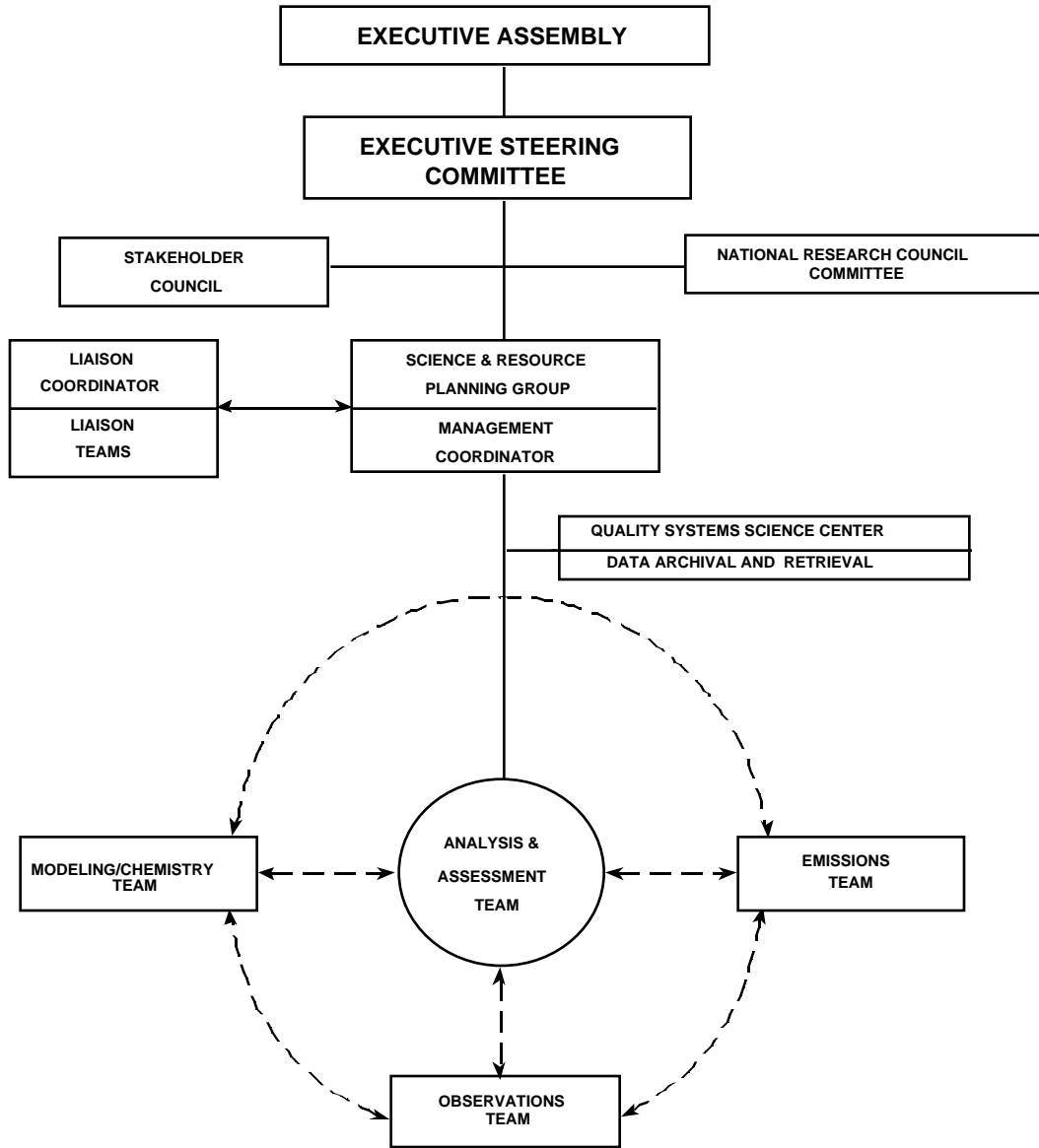


Figure 1-1: NARSTO Organization Chart

Inset 1-1: NARSTO Policy and Science Questions*

- 1-2.1 How can we determine the current trends in ozone concentrations and exposures on local and regional scales in North America?
- 1-2.2 How can we better understand, further identify, isolate, and explain the fundamental physical, chemical, and meteorological processes responsible for ozone accumulation on local and regional scales in North America?
- 1-2.3 How can we incorporate and use the evolving scientific understanding of relevant processes in diagnostic and prognostic tools (methods and models) for explaining observed phenomena and estimating impacts of future perturbations of independent variables, such as emissions and meteorology?
- 1-2.4 How do we evaluate and periodically assess the relative contributions of VOC's and NO_x , and their controls, to ozone accumulation on local and regional scales in North America?
- 1-2.5 What technologies and approaches are most cost-effective in achieving and maintaining ozone-precursor reductions and in reducing ozone concentrations and exposures?
- 1-1.1 For a given area, how do we determine whether an ozone problem exists, and how can we determine its severity?
- 1-1.2 For an area considered to have an ozone problem, what portion of the problem is essentially irreducible (based on such factors as natural emissions of ozone precursors and stratospheric influx of ozone) and what portion of the ozone problem is potentially controllable (based on anthropogenic precursor emissions to the troposphere)?
- 1-1.3 Do we have evidence that existing control measures are having an impact?
- 1-1.4 What are optimal approaches for reducing current and future high ozone concentrations for a given area considered to have an ozone problem?
- 1-1.5 What is the magnitude and impact of transnational-boundary transport of ozone and its precursors?
- 1-1.6 How can the relevant science and scientific uncertainties be communicated meaningfully to the air-quality management and policy communities? How can tropospheric ozone science be translated into actionable knowledge (changes in activity patterns) by the public?

*From NARSTO Research Strategy and Charter (1994).

2

OBJECTIVES, RATIONALE, AND APPROACH

2.1 Strategic Execution Plan Objectives

This Strategic Execution Plan derives directly from the *NARSTO Research Strategy and Charter*, and provides a quantitative description of the projected scientific program, including definitive characterization of near-term¹ scientific tasks, their schedules, their priorities, and their deliverable milestones. With the thrust of moving toward an effective and integrated pollution-management strategy, the Plan is intended to fulfill three programmatic functions, which are listed as follows:

1. It will be used as a primary tool for monitoring and steering program progress, and as a communication and coordination medium for all NARSTO participants.
2. It will be used extensively as a basic tool by the NARSTO Science and Resource Planning Group for research focus and selection, and for program-resource allocation decisions.
3. It will be applied as a means for communicating with, and stimulating or soliciting input from, stakeholders as well as interested parties that are external to the NARSTO team. The NARSTO client community, including government policy analysts, legislators, and administrators, is a particularly important group in this respect.

The primary objective of this Plan is to provide the working document that fulfills these three functions in the most effective and timely manner possible.

In stating this objective, it is important to note that the third function listed above is of paramount importance to the immediate NARSTO effort. Moreover, this activity entails a particularly challenging responsibility, owing to the complexity and uniqueness of the NARSTO research-allocation process. In view of this importance, this Plan places substantial emphasis on the Science and Resource Planning Group's immediate needs, leading to the following corollary objective:

A corollary objective of this Plan is to provide the NARSTO Science and Resource Planning Group with a working document that streamlines and facilitates its research support, selection, and allocation process, within the context of NARSTO's complex working environment.

¹ Defined over a three-to-five year time horizon.

In essence, this Strategic Execution Plan may be considered as a NARSTO blueprint for the next three-to-five year period, which is designed to accomplish these objectives. Optimal design of this blueprint depends strongly on several important features of NARSTO's operating environment. These are summarized in the section immediately following.

2.2 NARSTO and its Operating Environment

Several features of NARSTO's current operating environment directly influence program strategy, and thus the design of this Strategic Execution Plan. NARSTO is a newly conceived program, made up of older, on-going efforts as well as new initiatives. NARSTO is in its initial mobilization phase; thus coordination and startup considerations are important strategic factors. NARSTO has been conceived in the context of numerous past, ongoing, and anticipated studies, which have been addressing the tropospheric ozone issue on largely independent bases throughout the North American international community. Besides compiling, processing, and analyzing the information emerging from these efforts, NARSTO expects to identify and support additional "unique" research elements required to fill critical information gaps. The complexity and quasi-independent nature of current ozone studies, however, makes the precise specification of these additional research elements — and demonstration of their unique distinction from ongoing efforts — an extremely formidable task.

Precise specification of these elements is absolutely essential, however, for productive and efficient NARSTO operation. This is particularly challenging because ozone/NO_x/VOC chemistry is a relatively mature science, and specifying those additional research areas necessary for the optimal strategic treatment of the ozone issue is by no means trivial. Moreover, the problem of extracting this mature knowledge and applying it to different local and national decision processes presents itself as a problem of significant proportions.

The need for immediate and substantive NARSTO action is also an important factor influencing program strategy. Major driving forces for this include the immediate requirement for NARSTO products by policy analysts and decision makers to guide the revisions in standards, rules, and legislation that are expected to emerge during the late 1990's. This immediacy is amplified by the fact that the funding cycles of many NARSTO sponsoring organizations impose a considerable lag between project specification and actual implementation, underlining the need for a well-posed coordination and startup strategy to launch the program in as effective and expedient a manner as possible.

Finally, the heterogeneous nature of NARSTO membership is an important consideration. Originating from a mix of industrial, academic, and international governmental communities, individual members of this group function with a diversity of administrative procedures, fiscal cycles, and associated time scales. While the diversity of this public/private partnership offers numerous advantages, it is important that the NARSTO operational paradigm be designed carefully to maximize these potential benefits and to minimize possible drawbacks. In particular, it is essential at the outset to define NARSTO procedures for evaluating, selecting, and funding research elements in a manner that maximizes the advantages of organizational diversity, and to document these procedures in a manner that is widely understood throughout the NARSTO community.

The above environmental factors, including program startup, the need for immediate action, the challenge of defining research needs in the context of a loosely coordinated and complex field, and the diverse membership of NARSTO combine with a currently unsettled federal and private budgetary environment to make planning for NARSTO, as well as the creation of this plan, a challenging task. Basic elements of the Strategic Execution Plan prepared for this purpose are summarized in the section immediately following.

2.3 Strategic Execution Plan Structure

This Strategic Execution Plan is the first of a progressive blueprint series, which will be updated on roughly a three-year basis throughout the duration of NARSTO. As a consequence of NARSTO's current startup status, this initial version of the Plan is prepared as a three-part, staged document, which has been designed to facilitate the communication process. The present volume, Part 1, provides an introductory summary and fulfills the important function of describing the NARSTO operational protocol for research selection and resource allocation. Part 2 focuses specifically on the immediate needs for NARSTO's projected 1998 Assessment, while Part 3 deals with plans for a longer-term, focused research that will be necessary to support additional assessments, which are targeted beyond the 1998/1999 time-frame.

This three-part format has been chosen for several reasons, which reflect the operating environment described in Section 2.2. The stringent timing requirements of NARSTO's scheduled 1998 Assessment, driven by governmental decision-making schedules, necessitate that this portion of the Strategic Execution Plan be prepared and launched into action immediately. Moreover, the activity elements required for assessment preparation are relatively easy to define and justify, enabling this portion of the plan to be prepared in a straightforward manner.

In contrast, formulation of a longer-term research plan for NARSTO and the precise definition of its unique project elements is not at all straightforward. Complicated by

the noted array of ozone-related activities in NARSTO's external environment, this portion of the plan demands substantially more preparation time than is the case for the 1998 Assessment component. Moreover, the timing requirements for these longer-term project elements, while demanding, are less critical than their assessment-related counterparts in serving immediate decision-making needs.

For these reasons NARSTO has chosen the expedient of releasing first Parts 1 and 2 of this initial Strategic Execution Plan, and subsequently completing the entire document with the finalization of Part 3. As noted above, the organization of both Part 2 and Part 3 strongly reflects the NARSTO paradigm for evaluating its research options, selecting individual research projects, and "steering" ongoing projects to maximize their impact on relevant information gaps and policy questions. The following section provides an overview of this operational protocol and the key Strategic Execution Plan features required for its successful implementation.

3

NARSTO PROJECT SELECTION and ASSOCIATED SEP REQUIREMENTS

As noted in Section 2, it is important that the NARSTO project-selection and funding procedure be designed carefully, in order to enable efficient and expedient joint action by its diverse membership. It is also essential that this Strategic Execution Plan (SEP) be designed to facilitate this process to the maximum possible extent. The sections immediately below describe the evolution and nature of NARSTO's selection process and key requirements of this plan as an implementation tool.

3.1 Project Selection and Funding Procedure

NARSTO conducts research that is performed in-house by various members (in-kind contributions) as well as work that is conducted on an extramural basis through research grants, contracts, and other funding mechanisms. Responsibility for overall strategic planning, as well as the location and acquisition of programmatic funds resides primarily with the Executive Assembly (EA, cf. Figure 1-1), acting through its designated working group, the Executive Steering Committee (ESC). The NARSTO Science and Resource Planning Group (S&RPG) is responsible for detailed scheduling and planning, as well as for fund coordination of the extramural efforts. The *NARSTO Research Strategy and Charter* formally assigns the following responsibilities related to project funding, selection, and fund allocation:

EA/ESC:

- a. establish overall programmatic strategy
- b. acquire resources, both monetary and in-kind, as needed
- c. establish a process assigning resources to strategic activities.

S&RPG:

- a. balance the relative emphasis on program-level science/policy questions,
- b. define and coordinate the research needed to address the science and policy questions shown in Inset 1-1,
- c. prioritize program-level needs,
- d. identify and prioritize program-level activities

- e. identify program-level funds (or resources), and
- f. recommend which sponsoring organizations should take responsibility for funding which activities.

Here the overlap between the EA/ESC and S&RPG responsibilities — and the need for a strong coordination between the two groups — is obvious. It should be noted as well that while the *Research Strategy and Charter* assigns these responsibilities, it does not provide substantial guidance on procedures for their fulfillment. In view of this need for further definition, both the S&RPG and the EA/ESC have proceeded to design the working structures for implementing their assigned responsibilities. The paragraphs immediately below describe these actions.

S&RPG -Science Team Interactions

During its initial meeting in July 1995, the S&RPG concluded that a consensus-based operational protocol must be established before the Group can fulfill its basic mission. Two items were deemed particularly important in this regard. First, a formal procedure for assigning individual project elements for funding by specific sponsors must be defined, and second, some (again formal) means must be established for interacting with the NARSTO Science Teams (identified on the lower portion of Figure 1-1) to determine, prioritize, and schedule the research elements on both individual and collective bases. This was a pivotal meeting, which underscored the need for the current Strategic Execution Plan and, to a major extent, determined its basic composition.

The S&RPG concluded that it could best deal with the first requirement by establishing a coordination function for prioritization, selection, and funding/steering of research areas, and implementing an internal project “brokerage” for this purpose. Once the projects are identified and prioritized under this system, the brokerage process is designed to operate in a natural fashion under the guidance of selected S&RPG advocates to determine resources for, eliminate overlap of, ensure proper sequencing of, and otherwise expedite the selected research efforts. This has become known as the “Brokerage Model” within the S&RPG.

The S&RPG elected to deal with the second procedural requirement by establishing a formalism based on a conceptual model for interacting with the NARSTO Science Teams, which has become known as the “NARSTO Engine.” Figure 3-1 presents this model as an adaptation of the organizational structure shown in Figure 1-1, and includes only the Science Teams, the S&RPG, and the EA/ESC complex. Within this conceptual model, NARSTO Science Teams are charged with coordinating the production of a SEP (hexagonal box in Figure 3-1) which presents, from a

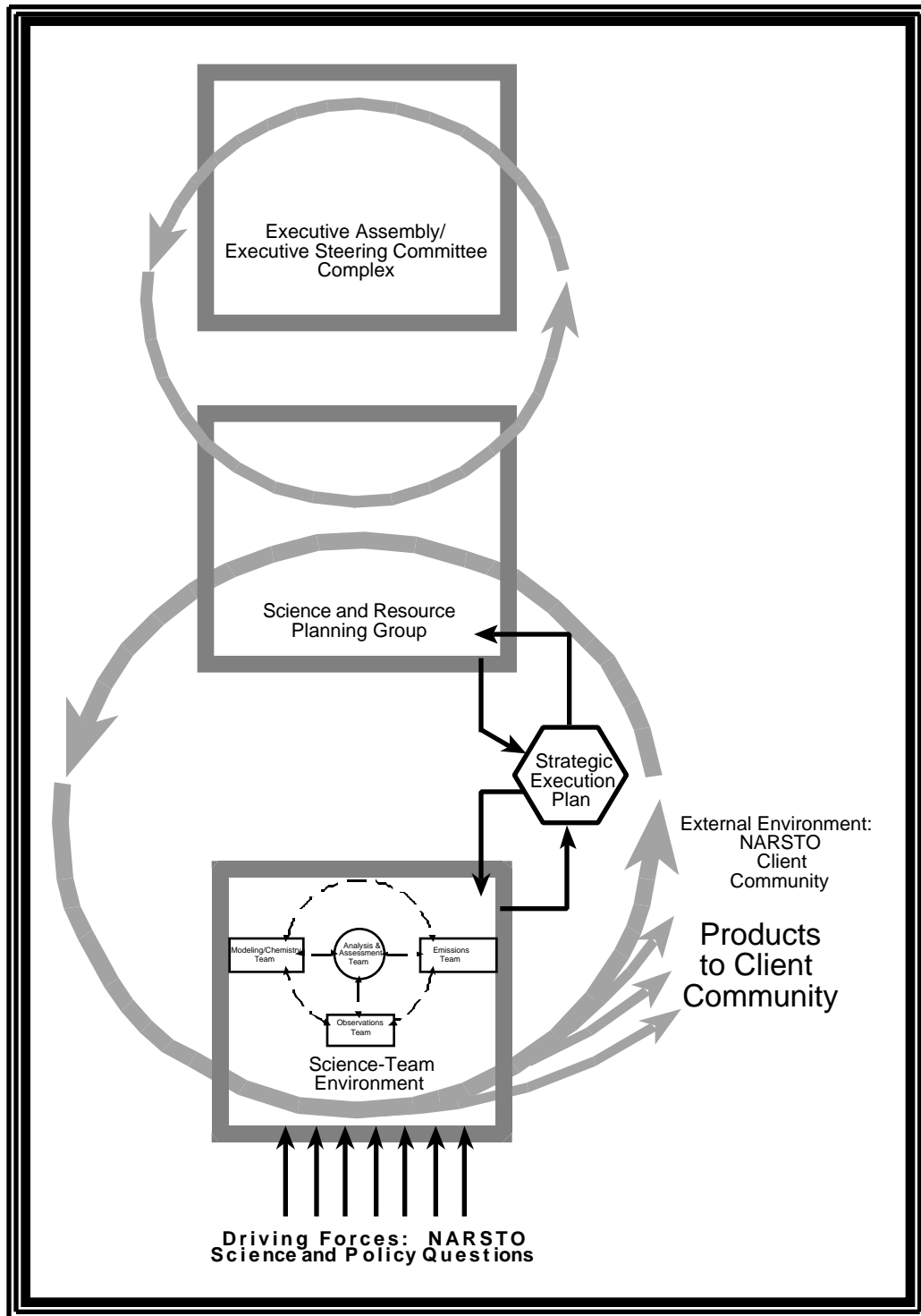


Figure 3-1: "NARSTO Engine" Conceptual Model for Science-Team—S&RPG and S&RPG—EA/ESC Interactions

science-oriented viewpoint, a projected program aimed at meeting the NARSTO goals in an optimal and expedient fashion. This Plan is to identify all required program elements, define their linkages with other elements, relate them specifically to NARSTO questions and objectives, prioritize them on the basis of importance and immediate needs, and define scheduling requirements. The SEP is to be considered as an updatable document with a three-year time horizon, but to provide a vision for future years' requirements as well.

The S&RPG further directed that the SEP be created on the basis of widespread input from the research community, both inside and outside of NARSTO. The Science Teams should be primarily responsible for coordinating the Plan's production, but input from all sources — both NARSTO and external — should be included as well. Members of the S&RPG should participate actively in the SEP's formulation, as should members of the Liaison Team and the Stakeholders' Council. All meetings associated with the Plan's creation should be open, with attendance by all persons welcome. As indicated by the large circular arrow in Figure 3-1, the creation and periodic updating of the Strategic Execution Plan is intended to occur as a cyclical process, with useful NARSTO products spinning off continuously as the program progresses along its scheduled track; hence the conceptual metaphor of the "NARSTO Engine."

Once prepared, the Strategic Execution Plan is to be forwarded to the S&RPG for direct application, both to perform its own prioritization of projects and to facilitate the brokerage process. *It is important to note that the S&RPG, not the Science-Team complex, is responsible for the selection and allocation function.* In contrast to the open meetings of the Science Teams, potential recipients of NARSTO funding are precluded from S&RPG meeting attendance to prevent possible conflict-of-interest situations.

Against this backdrop, the S&RPG - Science Team interaction can be envisioned as a bottom-up — top-down cycle. Drawing on a wide base of input from the science community, basic scientific information is fed, through the SEP, up to the S&RPG. The S&RPG then rechecks for redundancy with ongoing work, prioritizes, and selects specific elements to be funded. When such funding does indeed occur, the activity is delegated to the Science Teams, who act to coordinate the project within the total NARSTO effort, and to work with the S&RPG to maximize the associated scientific and policy-analysis benefits.

It is intended that NARSTO projects should draw scientists from the university community, government agencies, and private industry to incorporate the best talent pool possible, in a manner such that individual NARSTO organizations can apply their own funding protocols conveniently for implementation purposes. Once a project is selected for extramural funding and a NARSTO sponsor is identified to support the effort, that particular sponsor determines the corresponding person(s) or organization(s) to perform the actual work using its own administrative procedures.

Such procedures vary widely among NARSTO sponsoring organizations, but a common intent is to present uniform accessibility to all interested parties. With few exceptions RFP's for NARSTO extramural projects will be announced on the NARSTO home page (<http://narsto.owt.com/Narsto/>) as well as other media.

It is important to observe that, although the formalism of S&RPG action through the SEP has been designed purposely into the system, members of the S&RPG are encouraged to interact in a proactive fashion with the Science Teams on a continuous and less formal basis by attending Science-Team planning meetings and making frequent personal contacts. Thus, both formal and informal modes of interaction are intended and encouraged, with the expectation that informal input to the S&RPG will result in planning that is of maximum utility for the Group's direct and immediate application.

EA/ESC - S&RPG Interactions

During 1995 and 1996, S&RPG efforts to define and implement NARSTO activities were strongly inhibited by the lack of a formal and active dialogue between the S&RPG and the EA/ESC complex which, as indicated above, has primary responsibility under the Charter for acquiring monetary and in-kind resources. Recognizing this, the Executive Assembly met during January 1997 and resolved to implement a regular meeting schedule for both the EA and the ESC. Under this resolution the EA will meet annually with the ESC and address, in addition to other matters, programmatic thrusts and resource requirements for the coming year. The ESC will hold two additional planning meetings per year. One of these will be a joint meeting with the S&RPG, which is intended to provide two-way information flow and address the overlapping responsibilities itemized above. The second, which is scheduled later in the calendar year, will be devoted primarily to defining decision items for consideration at the subsequent EA meeting, establishing associated programmatic strategies and schedules, and identifying related budgetary needs. In essence, this regular meeting sequence is intended as a formalism which adds a second cyclical process as indicated by the additional, smaller circular arrow in Figure 3-1.

3.2 Strategic Execution Plan Requirements

From the preceding discussion it is evident that the efficiency of NARSTO's research allocation and funding protocol will depend heavily on the ability of the Science and Resource Planning Group to use this Plan effectively for selecting and deploying the associated scientific effort. In this respect, it is important to recall that the S&RPG's mission is particularly challenging because a substantial complex of ozone research is already in progress, funded through a variety of channels.

Several categories of ongoing and/or required research exist in this regard:

- Category 1. New activities that are necessary to the NARSTO mission, but are not currently in progress.
- Category 2. Activities currently in progress, which are funded by NARSTO member organizations and conducted through research-grant or contract arrangements to third parties.
- Category 3. Internal activities currently in progress by NARSTO member organizations, considered as "in-kind" contributions to the program.
- Category 4. Relevant activities, which are currently in progress and are conducted by organizations external to the NARSTO environment.

The primary mandate for the S&RPG is to select and identify/allocate funds for Category-1 activities, as well as to influence Category-2 and Category-3 activities in a manner such as to maximize NARSTO benefit. In fulfillment of this responsibility, it is imperative that this Group maintain a strong cognizance of activities in Category 4, in order to ensure the most cost-effective deployment of NARSTO resources. In view of the substantial amount of activity currently in progress, this is a challenging task, which requires continuing surveillance by NARSTO's Management Coordinator and the Science Teams, as well as by the S&RPG.

In reflection of this environment and the goals described in Section 1.3, it is particularly important that the SEP incorporate the following features:

1. The research tasks submitted for consideration by the S&RPG must be acknowledged to fall squarely into Category 1, as described above. Sufficient documentation of peripheral activities should be given to demonstrate that these tasks are not duplicative of ongoing efforts.
2. The research tasks submitted to the S&RPG must appear as discrete, modular packages, which the S&RPG can assimilate into its brokerage system easily and support or fund in a convenient manner. Definition of these "discrete program elements" is a feature of critical importance: unbounded and amorphous projects will be almost impossible to support and conduct within the NARSTO system.
3. The research plans submitted by the teams must exhibit a high level of client awareness and customer orientation.

4. The research tasks should be visibly and obviously related to the specific NARSTO science and policy questions appearing in Inset 1-1.
5. The individual research agendas should be given an initial prioritization according to their expected importance in fulfilling clients' needs, their roles in addressing key science and policy questions, and sequencing requirements with other program elements of the overall NARSTO plan. These prioritizations should be expressed in a manner that facilitates the S&RPG selection process and is convenient for downstream reprioritization by the S&RPG.
6. The research plans must reflect the central role of assessment in the NARSTO process, and recognize the Analysis and Assessment function as a primary internal customer for the more basic research. This is not intended to mean that NARSTO expects to focus solely on assessment; indeed, NARSTO intends to pursue extensively the development of numerous scientific facets of ozone and related air-chemistry issues. All elements within the SEP must, however, have a strongly policy-relevant orientation, in the sense intended by the Federal Committee on Environmental and Natural Resources (CENR, 1994).
7. The individual research tasks should be accompanied by cost estimates, again for use by the S&RPG in their prioritization and brokerage process. These cost estimates should be considered as approximate and subject to modification after downstream processing by the S&RPG.
8. Finally, the ensemble of research tasks described in the SEP should be quantitative and complete, in the sense that no tasks that are essential to the two-to-three year time horizon of the report have been omitted, inadvertently or otherwise.

As noted previously, the inventory of NARSTO research appearing in Appendix 1-A has been prepared as a summary of ongoing NARSTO activities to aid the S&RPG in its evaluation of current sponsor plans, setting priorities for new research, and integrating its selection of new activities with ongoing efforts. Part 2 and Part 3 of this Strategic Execution Plan also reflect this inventory, and have been prepared to fulfill the requirements itemized above.

References

National Research Council (1991). *Rethinking the Ozone Problem in Urban and Regional Air Pollution*. National Academy Press, Washington, DC.

NARSTO (1994). *Research Strategy and Charter*. (Available as a downloadable file on the NARSTO Web site, <<http://narsto.owt.com/Narsto/>>)

CENR (1994). *National Forum on Environment and Natural Resources R&D*. Office of Science and Technology Policy, Washington DC, March 28-30.

Appendix 1-A

Inventory of Ongoing NARSTO Activities

Table 1-A-1: NARSTO SPONSORING ORGANIZATIONS	SPONSOR ID CODE
FEDERAL SPONSORS	
DEPARTMENT OF AGRICULTURE -- FOREST SERVICE	USDA
DEPARTMENT OF COMMERCE -- NOAA	NOAA
DEPARTMENT OF ENERGY -- OFFICE OF ENERGY RESEARCH	DOE
DEPARTMENT OF ENERGY -- RENEWABLE ENERGY LAB	NREL
DEPARTMENT OF INTERIOR -- PARK SERVICE	DOI
DEPARTMENT OF TRANSPORTATION	DOT
ENVIRONMENT CANADA	AES
ENVIRONMENTAL PROTECTION AGENCY -- OFFICE OF AIR & RADIATION	OAR
ENVIRONMENTAL PROTECTION AGENCY -- OFFICE OF RESEARCH & DEVELOPMENT	ORD
INSTITUTO MEXICANO del PETROLEO	IMP
INSTITUTO NATIONAL de ECOLOGIA	INE
NATIONAL SCIENCE FOUNDATION	NSF
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	NASA
TENNESSEE VALLEY AUTHORITY	TVA
STATE SPONSORS	
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY	CARB
COMMONWEALTH OF PENNSYLVANIA	PADER
LAKE MICHIGAN AIR DIRECTORS CONSORTIUM	LMADC
LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY	LDEQ
MARYLAND DEPATRMENT OF THE ENVIRONMENT	MDE
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION	MADEP
MID-ATLANTIC REGIONAL AIR MANAGEMENT ASSOCIATION	MARAMA
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY	NJDEPE
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION	NYDEC
NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT	NESCUAM
TEXAS NATURAL RESOURCES CONSERVATION COMMISSION	TXNRCC

Table 1-A-1: NARSTO SPONSORING ORGANIZATIONS (Cont'd)	SPONSOR ID CODE
AUTO & OIL SPONSORS	
AMERICAN PETROLEUM INSTITUTE COORDINATING RESEARCH COUNCIL FORD MOTOR COMPANY GENERAL MOTORS CORPORATION	API CRC FORD GM
INDUSTRIAL SPONSORS	
DUNN-EDWARDS CORPORATION E. I. DUPONT de NEMOURS & COMPANY EASTMAN KODAK COMPANY	D-E DuPONT KODAK
UTILITY SPONSORS	
ATLANTIC ELECTRIC ALLEGHENY POWER SERVICE CORPORATION BALTIMORE GAS & ELECTRIC COMMONWEALTH EDISON COMPANY DUQUESNE LIGHT COMPANY EDISON ELECTRIC INSTITUTE ELECTRIC POWER RESEARCH INSTITUTE EMPIRE STATE ELECTRIC ENERGY RESEARCH CORPORATION GENERAL PUBLIC UTILITIES SERVICE CORPORATION NEW ENGLAND ELECTRIC SYSTEM NIAGARA MOHAWK POWER CO. NORTHERN INDIANA PUBLIC SERVICE COMPANY NORTHERN STATES POWER COMPANY NORTHEAST UTILITIES SERVICE CO. NY STATE ELECTRIC & GAS OHIO EDISON COMPANY PECO ENERGY CO. PENNSYLVANIA POWER & LIGHT CO. POTOMAC ELECTRIC POWER COMPANY PUBLIC SERVICE ELECTRIC & GAS COMPANY SOUTHERN COMPANY THE UNITED ILLUMINATING COMPANY	ATLANTIC APSC BG&E CEC DLC EEI EPRI ESEERCO GPU NEES NIAGARA NIPSC NSPC NUSCO NYSEG OEC PECO PP&L PEPCO PSE&G SOCO UIC

Table 1-A-2: NARSTO PARTICIPATING PARTNERS*

UNIVERSITIES

GEORGIA INSTITUTE OF TECHNOLOGY
NORTH CAROLINA STATE UNIVERSITY
STATE UNIVERSITY OF NEW YORK
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY OF ALABAMA, HUNTSVILLE
UNIVERSITY OF CALIFORNIA, IRVINE
UNIVERSITY OF CALIFORNIA, RIVERSIDE
UNIVERSITY OF COLORADO, BOULDER
UNIVERSITY OF MARYLAND
UNIVERSITY OF MIAMI
UNIVERSITY OF MICHIGAN
UMDNJ - ROBERT WOOD JOHNSON MEDICAL CENTER

CONTRACTORS AND OTHERS

EARTH TECH
ENERGY & ENVIRONMENT SUBCOMMITTEE, HOUSE OF REPRESENTATIVES, U.S. CONGRESS
ENVIRONMENTAL SCIENCES & ENGINEERING, INC.
MICROELECTRONICS CENTER OF NORTH CAROLINA
MIDWEST RESEARCH INSTITUTE
RESEARCH TRIANGLE INSTITUTE
SONOMA TECHNOLOGY, INC.
THE SOUTHERN OXIDANT STUDY

*Participating Partners have each signed the NARSTO Charter to symbolize their support for the NARSTO research agenda. Participating Partners are potential recipients of work and resources from NARSTO sponsoring organizations. Therefore, to ensure their protection against conflict of interest issues, they may not serve on the Executive Assembly, the Executive Steering Committee or the Science and Resource Planning Group. They may place a representative on each of the Technical Program Teams, Liaison Teams, and the Stakeholder Council.

NARSTO Strategic Execution Plan: Part 1

Table 1-A-3 below shows estimated NARSTO budgets for the years 1995 through 1998, for program management and research, broken down by research category. Numbers shown here for federal, state, industry, and utility categories represent the total contribution by all US NARSTO members. Canadian and Mexican contributions are aggregated across all categories. Amounts presented here are based totally on response by NARSTO members to financial questionnaires from the NARSTO Management Coordinators, and should be viewed as somewhat inaccurate indicators of actual values. Accuracy and specificity of similar tables will improve in future years, as responses to inventory requests become more well-defined.

Table 1-A-3: ESTIMATED NARSTO BUDGETS

1995	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	Research
NARSTO BUDGET	Federal	State	Industry	Utilities	Canada	Mexico	TOTAL	Category
OBSERVATIONS	20,264	12,332	490	8,810	973	900	43,769	64.1%
MODELING & CHEMISTRY	8,940	823	2,037	550	973	480	13,803	20.2%
EMISSIONS	3,396	1,770	2,144	5	243	600	8,158	12.0%
ANALYSIS & ASSESSMENT	425	5	0	880	243	150	1,703	2.5%
MANAGEMENT	660	21	0	0	0	150	831	1.2%
TOTAL CONTRIBUTION	33,685	14,951	4,671	10,245	2,432	2,280	68,264	
PERCENT OF TOTAL	49.35%	21.90%	6.84%	15.01%	3.56%	3.34%		

1996	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	Research
NARSTO BUDGET	Federal	State	Industry	Utilities	Canada	Mexico	TOTAL	Category
OBSERVATIONS	32,167	16,799	475	3,900	1,544	0	54,885	76.5%
MODELING & CHEMISTRY	7,353	181	555	596	229	0	8,914	12.4%
EMISSIONS	3,716	38	1,310	0	0	0	5,064	7.1%
ANALYSIS & ASSESSMENT	1,125	22	0	970	100	0	2,217	3.1%
MANAGEMENT	599	29	0	0	30	0	658	0.9%
TOTAL CONTRIBUTION	44,961	17,069	2,340	5,466	1,903	0	71,739	
PERCENT OF TOTAL	62.67%	23.79%	3.26%	7.625	2.65%	0.00%		

Table 1-A-3, Continued: ESTIMATED NARSTO BUDGETS

1997	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	Research
NARSTO BUDGET	Federal	State	Industry	Utilities	Canada	Mexico	TOTAL	Category
OBSERVATIONS	30,261	15,050	300	2,854	500	0	48,965	68.1%
MODELING & CHEMISTRY	10,178	90	205	590	200	0	11,263	15.7%
EMISSIONS	5,465	38	1,850	0	0	0	7,353	10.2%
ANALYSIS & ASSESSMENT	2,683	10	0	750	0	0	3,443	4.8%
MANAGEMENT	816	20	0	0	30	0	866	1.2%
TOTAL CONTRIBUTION	49,403	15,208	2,355	4,194	730	0	71,890	
PERCENT OF TOTAL	68.72%	21.15%	3.28%	5.83%	1.02%	0.00%		

1998	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	(\$K)	Research
NARSTO BUDGET	Federal	State	Industry	Utilities	Canada	Mexico	TOTAL	Category
OBSERVATIONS	9,805	216	0	2,307	500	0	12,828	58.8%
MODELING & CHEMISTRY	4,116	110	85	502	200	0	5,013	23.0%
EMISSIONS	2,200	38	0	0	0	0	2,238	10.3%
ANALYSIS & ASSESSMENT	1,675	10	0	0	0	0	1,685	7.7%
MANAGEMENT	17	20	0	0	30	0	67	0.3%
TOTAL CONTRIBUTION	17,813	394	85	2,809	730	0	21,831	
PERCENT OF TOTAL	81.59%	1.80%	0.39%	12.87%	3.34%	0.00%		