FEASIBILITY OF A REGIONAL MARKET-BASED NO_X BUDGET SYSTEM FOR THE OZONE TRANSPORT REGION

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Prepared for:
Northeast States for Coordinated Air Use Management
(NESCAUM)

and

Mid-Atlantic Regional Air Management Association
(MARAMA)

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The report also benefited from extensive input from an Ad Hoc Committee whose members included representatives from the electric utility industry, the natural gas industry, independent power producers, state public utility commissions, and environmental groups, as well as input from NESCAUM's Stationary Sources Review Committee.

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1.0 EXECUTIVE SUMMARY

Current assessment of the ozone problem in the Northeast suggests that the twelve eastern states in the Ozone Transport Region (OTR) will need to reduce NO_x emissions substantially beyond the reductions represented by the application of Reasonably Available Control Technology (RACT) and other mandated actions in Titles I and IV of the Clean Air Act Amendments of 1990 (CAAA) in order to attain the National Ambient Air Quality Standard (NAAQS) for ground-level ozone. It is in the states' best interest to identify and evaluate optimum NO_x reduction strategies including market-based approaches which will provide the needed reductions in a cost-effective manner.

The purpose of this study is to provide states in the OTR with a conceptual design of a regional, market-based NO_x budget system for the principal stationary sources that emit NO_x in the OTR (electric generating units and large industrial boilers) and to evaluate the feasibility of implementing this budget system. The conceptual design outlined in this report is offered as a first or interim approximation, to serve as a basis for discussion, debate, and evaluation as a full-fledged emissions budget system is developed. This conceptual design has been formulated to provide states with an innovative, cost-effective approach for achieving NO_x emission reductions.

A NO_x emission budget system is a strategy that would address the mandate of the CAAA to implement measures sufficient to allow the region to achieve the NAAQS for ozone. It is a measure that would limit the tons of NO_x allowed to be released into the atmosphere. NO_x allowances (emission authorizations) will be allocated each year to the affected sources from the NO_x budget total for each budget zone. It is recommended that two or three budget zones be defined and that all of the OTR be included in one of these. The final number and boundaries of the budget zones will be consistent with those adopted by the OTR.

Market trading of NO_x allowances is the mechanism for reducing overall compliance costs within a NO_x budget. Trading allows one emission source to over-control and trade excess allowances to another source that under-controls.

Market-based systems for air pollution control enhance the underlying regulatory structure by providing incentives for compliance with regulations more quickly, more efficiently, more cost-effectively, and in ways which may foster innovative approaches to air pollution control. In five areas analyzed in this report, the proposed NO_x emissions budget and allowance trading system offers distinct advantages over a traditional, command and control alternative using emission rate limits and emission reduction credit (ERC) trading. These advantages are in the areas of:

- economic effects on industry;
- economic effects on government;
- economic development effects;
- tendency to encourage innovation in air pollution control; and
- the certainty of achieving emission reduction goals expeditiously.

In an allowance based system, how the allowances are defined, allocated to sources, and traded are the key issues, and those are discussed in this report. The actual value of the regional mass emissions budget for future years is not established in this study and would be set by states in the OTR as the OTC's Phase II NO_x control policy is developed. The proposed NO_x emissions budget system was developed through an extensive consultative process involving:

- An Ad Hoc Committee consisting of likely affected stakeholders throughout the OTR such as: electric utilities, power pools, environmental groups, natural gas companies, state public utility commissions, and the Ozone Transport Commission (OTC); and

- A joint NESCAUM/MARAMA Emission Trading Workgroup representing all of the States. Representatives of the EPA Policy Office and EPA Regions I, II and III also participated in the Workgroup.

This report represents one component of a three-part process that needs to be completed in order for a regional, market-based NO_x emissions budget system to be implemented. For the first component, the members of the OTC are establishing target levels for NO_x reductions beyond those required by RACT. The OTC has been informed of the interaction of the Ad Hoc Committee and Emission Trading Workgroup in the evolving progress of this project, which has worked to develop the NO_x budget system for achieving the reductions (Component 2). Finally, the Emission Trading Workgroup is composed of the state staff members who will have the responsibility of working with EPA to integrate the NO_x budget mechanism with their State Implementation Plans (SIP's) (Component 3).

This feasibility study was guided by the following key principles:

1. To promote innovative, cost-effective approaches to NO_x emissions reduction by stationary sources in the OTR;

2. To provide stationary sources in the OTR more flexibility in meeting post-RACT NO_x control requirements through options such as energy conservation and seasonal fuel switching; and to provide sources more certainty since reduction targets will be known in advance;

3. To increase the certainty of NO_x emission reductions for the OTR states and in so doing assist them in achieving ozone attainment.

4. To encourage some sources to make reductions in NO_x emissions earlier than they would have otherwise.

5. To satisfy EPA's promulgated rules for a discretionary Economic Incentive Program (EIP), which is the most flexible mechanism available for implementing an interstate control program.

The proposed NO_x budget system is summarized as follows. (A more detailed summary is given in Chapter 6 and a full discussion of the program parameters is presented in Chapter 5.) The NO_x budget for each of the budget zones will be set in advance each year by the states and will decline with time by steps every two or three years as needed, to advance the goal of attaining the ozone standard. The budget will be allocated in the form of NO_x allowances to the affected sources: all electric generating units (utility or NUG) with a rated output of 15 MW or more, and all industrial boilers with a heat input of 250 MMBtu/hr or more. Allocation may be either fuel specific or fuel independent. Allowances will not confer property rights. An allowance will authorize a source to emit one ton of NO_x per ozone season in a particular year.

Allowances will be marketable emissions authorizations within the budget zone in which the source to which they are allocated is located, that is they may be bought, sold or traded for use during their designated year to any other source located within the budget zone. Trading between budget zones will be subject to exchange rates. To encourage early reductions of NO_x, banking of unused NO_x allowances by affected sources for use in a future year will be allowed, although such use may be regulated by mechanisms developed by states to ensure that the banked emissions used in any ozone season would not exceed the level consistent with meeting SIP commitments.

Allowances will also be available for purchase to satisfy emission offset requirements of New Source Review through two mechanisms: from a set-aside account for new sources in attainment areas, and on the open market for sources in all areas.

While this report makes certain recommendations for the design of program parameters, what will be important in the final analysis is to strike the right balance in the system design between elements of stringency and elements of flexibility. The former include the size of downward reductions in the NO_x emissions budget and how early reductions occur. The latter includes factors such as: the duration of the averaging period for the mass emissions budget; whether banking is allowed and how restricted it is; the size of the trading area; and when the end of the trading season occurs each year, i.e., the true-up period. Unless an optional balance is achieved, the system will either fail to achieve its environmental objective or will achieve its environmental objective at the cost of imposing unnecessary regulatory burdens on the affected sources.

A review of technologically feasible NO_x control methods for the affected sources reveals that today's retrofit technology can achieve NO_x emission rates at or below 0.10 lb/MMBtu in most cases. SCR in combination with combustion controls has been demonstrated to lower NO_x emissions for coal-fired boilers down to 0.05 lb/MMBtu, for oil-and gas-fired boilers down to 0.02 lb/MMBtu, and for gas turbines down to 0.03 lb/MMBtu.

Enforcement will be based on Continuous Emissions Monitoring Systems (CEMS) data submitted by each source for the ozone season and other provisions identified in sources' Operating Permits. Administration of a budget system will require the involvement of both the states and a regional organization. A central registry will be maintained to track the allocation, use, trading and banking of NO_x allowances in each state, budget zone, and in the OTR. In addition to maintaining the registry, the regional organization will be responsible for actually allocating allowances to existing sources and running the auction of allowances from the set aside account to new sources each year. Individual state responsibilities in administration will include: data collection; compliance assurance; enforcement; audit procedures; and reconciliation procedures, should the audit indicate that actual emissions reductions are less than projected emission reductions.

A review of the essential elements of a discretionary EIP, as set forth in EPA's April 7, 1994 Economic Incentive Program rules, shows that the proposed NO_x budget system is compatible with those rules and can be implemented as an EIP in the SIP's of the states in the OTR.

As part of this study, an emissions data base for all affected stationary sources in the OTR was assembled from EPA's 1990 Interim Emission Inventory. The EPA data were used to project NO_x emissions for 1995 and 2003. Four NO_x budget scenarios for 2003 were then analyzed that applied budget emission rates of 0.10-0.25 lb/MMBtu to the aggregate ozone season heat input (MMBtu/season) for all affected sources. The analysis demonstrated that a NO_x budget based on an average emission rate across the OTR of 0.15 lb/MMBtu, would produce peak ozone day NO_x reductions of about 70% relative to a 1990 baseline, and annual NO_x reductions of about 23%.

In conclusion, a regional, market-based NO_x emissions budget system for stationary sources in the OTR states is feasible and will provide needed NO_x reductions in a flexible, cost-effective way that helps the states meet their obligations under the Clean Air Act.

2.0 INTRODUCTION

2.1 A Regional Market-Based Approach

Elevated concentrations of ground-level ozone along the east coast are a regional problem due to the nature of the pollutant: it is not directly emitted, but rather is created by chemical reactions in air masses traveling long distances. In writing the 1990 Clean Air Act Amendments (CAAA), Congress recognized that the ozone problem can not be solved by individual states acting on their own, but only in a coordinated, regional effort. As a result, the CAAA established a regional control area called the Ozone Transport Region (OTR), extending across twelve eastern states* (see Figure 1). The required application of VOC and NO_x control measures throughout the OTR reflects Congress' understanding that the ozone problem is not limited by state boundaries.

EPA's regional oxidant modeling for northeast transport (ROMNET) also underscores the regional nature of the east coast ozone problem. Current assessment of the ozone problem in the Northeast suggests that the OTR states will need to reduce NO_x emissions substantially beyond the reductions in 1995 represented by Reasonably Available Control Technology (RACT) and other specified actions in Title I of the CAAA in order to attain the National Ambient Air Quality Standard (NAAQS) for ozone. It is in the best interest of the OTR States to identify and evaluate NO_x reduction strategies which will provide environmental benefits in a cost-effective manner. <u>A regional, market-based approach</u> using NO_x <u>allowances</u> (emission authorizations) would allow sources greater flexibility in meeting NO_x reduction goals at a lower cost than a command-and-control approach using emission rate limits. The economic efficiency of market-based regulations has been studied

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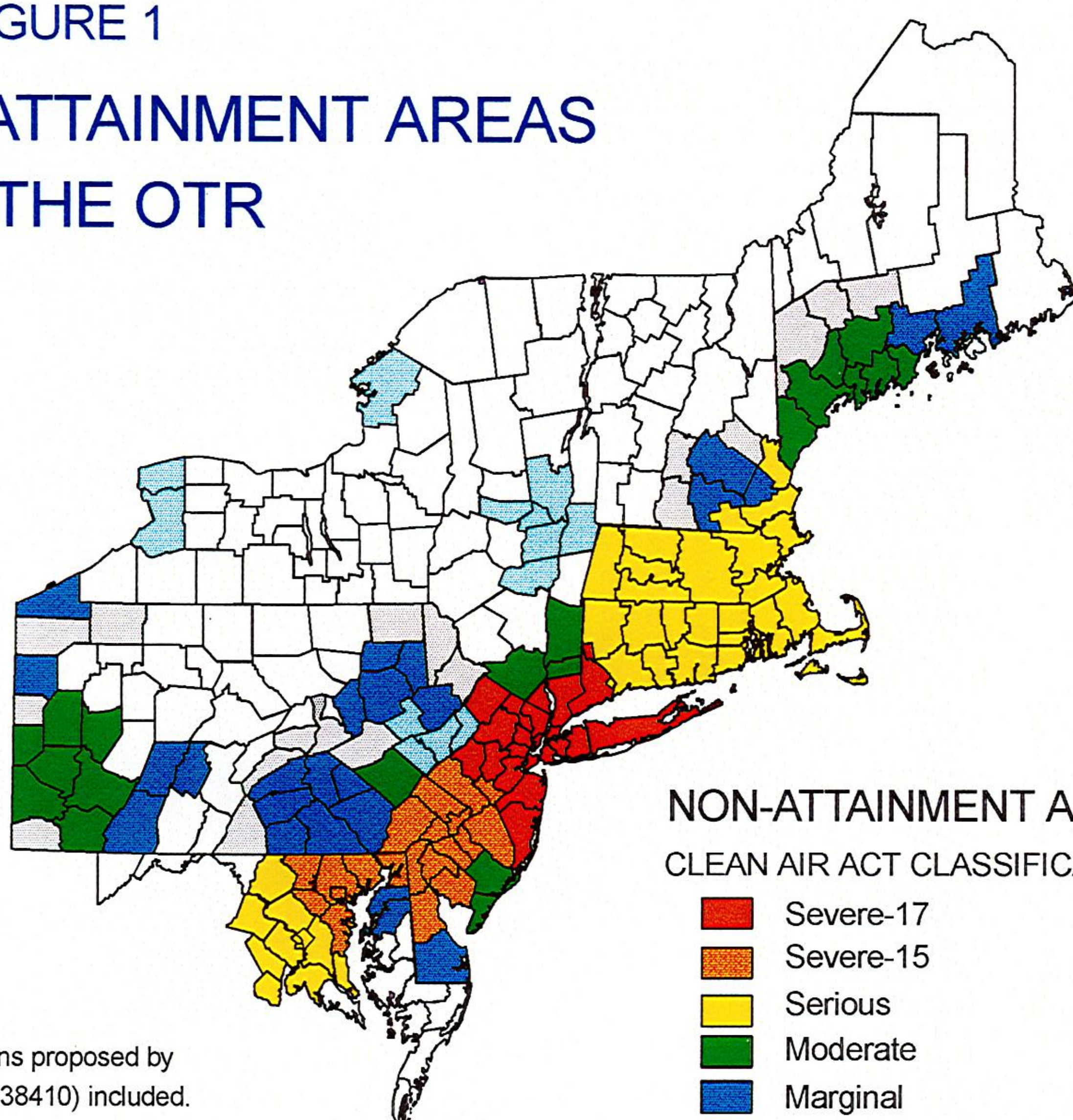
*The OTR consists of the four mid-Atlantic States (PA, MD, DE, and five northern counties in VA), the District of Columbia, and eight Northeast States (NJ, NY, CT, RI, MA, VT, NH, and ME).

FIGURE 1

OZONE NON-ATTAINMENT AREAS IN THE OTR



NON-ATTAINMENT AREAS

CLEAN AIR ACT CLASSIFICATIONS

- Severe-17
- Severe-15
- Serious
- Moderate
- Marginal
- Marginal and Attainment
- Areas with insufficient air quality data but previously designated non-attainment

Source: 40 CFR 81 with reclassifications proposed by EPA on July 28, 1994 (59 FR 38410) included.

and documented by EPA and others.[1,2,3,4] The economic efficiency of market-based regulations is discussed fully in Chapter 9 and a discussion of other market-based programs is given in Appendix A. EPA estimates that the cost savings of market-based regulations over command-and-control saved $220 million in the gasoline lead phasedown rule and will save somewhere between $1 billion and $10 billion in the Title IV acid rain program.[1,2,3,4,5] The logic of a regional approach is further supported by the interstate design of pollutant source infrastructures, such as utility grids and transportation networks.

A NO_x emissions budget** system which provides for the trading of allowances has received increased attention as a regional, market-based strategy for obtaining post-RACT NO_x emission reductions at stationary sources throughout the OTR. The NO_x budget is a clear concept that addresses the final requirement for ozone attainment: limiting the tons of a precursor pollutant released into the atmosphere. Allowance trading is the mechanism for reducing overall compliance costs within a NO_x budget system. Such trading allows one emission source to over-control and trade surplus <u>allowances</u> to another plant that under-controls. When trading is encouraged, the allowances begin to resemble a commodity and market forces work to ensure that pollution control costs are minimized. In this manner, a regional NO_x budget system, in conjunction with allowance trading, will provide cost savings to the Mid-Atlantic and Northeast States in their ozone control plans.

A regional NO_x budget system with allowance trading is a control strategy consistent with the provisions of the CAAA, that encourage states to improve air quality through market-based approaches, and it is a logical extension of EPA's 1986 Emissions Trading Policy[6] and EPA's 1994 Economic Incentive Program (EIP) Rules.[7] The primary objective of this study is to provide states in the OTR with a conceptual design of a budget system. This conceptual

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**The term "budget" used throughout this report is often called an emissions "cap" by others.

design is offered as a first or interim approximation, to serve as a basis for discussion, debate, and evaluation as a full-fledged emissions budget system is developed. This conceptual design has been formulated to provide states with an innovative, cost-effective approach to NO_x emissions reduction. It will be a challenge for the OTR States to accomplish the large VOC and NO_x reductions needed to achieve compliance with the ozone NAAQS. This underscores the need to encourage innovative control strategies and to find ways to lower the costs of control. The underlying economic realities reinforce the desirability of a regional program. For example, the larger trading area represented by a region will provide economies of scale and fewer state-to-state inequities for business than many isolated state trading programs. A regional budget system with allowance trading will provide a greater incentive for: implementing energy conservation measures; switching to cleaner fuels; and implementing aggressive control technology on sources where such controls will be most cost-effective. By encouraging the use of innovative technologies, this approach also encourages the development of new technologies. Meeting the requirements of the CAAA for ozone attainment will be very expensive and becomes more attainable if the problem is addressed on a regional basis using market-based solutions.

This report is a feasibility study of a possible NO_x budget program for the states in the OTR. In an allowance based trading system, how the allowances are defined, allocated to sources, and traded are the key issues, and those are discussed in this report. The actual value of the regional mass emissions budget for future years is not established in this study and will be set by states in the OTR when the program is implemented.

A brief description of the budget program is as follows. The "NO_x budget" is a regulatory limit on the total tons of NO_x released into the atmosphere by a defined group of stationary sources, the "affected sources", within a geographic area called the "budget zone". There may be multiple budget zones with separate NO_x budgets. The "control period" is the "ozone season" (May 1 -

September 30). The value of the NO_x budget for the control period in the budget zone will be set in advance for each year by the participating states, and will decline with time by a "number of steps" as needed to advance the goal of attaining the federal ozone health standard. The total budget value will be converted into an equivalent number of "NO_x allowances" each with the value of one ton of emissions. These allowances will be allocated to the affected sources and will represent the currency of the allowance trading system. They will be allocated anew for each year's ozone season to affected sources, and each allowance will authorize an affected source to emit 1 ton per ozone season during a particular year.

Allowances will not confer property rights on the facility owners holding them. Rules have been developed for handling "moth-balled units", those that rarely operate, and "shutdown units". "Allowance trading" is the mechanism for reducing overall compliance costs within the budget zone by allowing one affected source (with lower marginal control costs) to over-control and trade excess allowances to another affected source (with higher marginal control costs) that under-controls.

Allowances will be marketable emission authorizations within the budget zone, meaning they may be bought, sold or traded for use during their designated control year to any other source within the budget zone. Trading between budget zones will be subject to exchange rates (see Section 5.10). To encourage early reductions of NO_x, "banking" of unused NO_x allowances by affected sources for use in a future year is considered in this study (see Section 5.11).

Allowances may possibly satisfy other Clean Air Act requirements such as emission offsets or netting, subject to restrictions in existing EPA regulations and policies. This allowance trading program is not directly related to New Source Review (NSR) though it may assist new sources in complying with NSR. A full discussion of using allowances to satisfy emission offset requirements is given in Section 5.8.

To encourage NO_x reductions in as wide an area and by as many sources as possible, it may be possible for an Emission Reduction Credit (ERC) trading program to be created for source types not in the NO_x budget system (e.g., smaller stationary sources, area sources, or mobile sources). Thus, an "ERC" would be a unit of NO_x emission reduction from a source outside the NO_x budget program that is documented to be real, surplus, enforceable, permanent and quantifiable. A mechanism for translating these ERC's into allowances could be specified so that non-regulated sources may opt-in to the program.

While this report makes certain recommendations, it is important to strike the right balance in the system design between elements of stringency and elements of flexibility. The former include the size of downward reductions in the NO_x emissions budget and how early reductions occur. The latter includes factors such as: the duration of the averaging period for the mass emissions budget; whether banking is allowed and how restricted it is; the size of the trading area; and when the end of the trading season occurs each year, i.e., the true-up period.

The remainder of this chapter provides an overview of the background of this feasibility study and presents the assumptions for the study. Chapter 3 discusses the principles that have guided this study, while Chapter 4 lists the definitions used in the NO_x budget design. A detailed discussion of the design parameters for the budget system is provided in Chapter 5, with a summary of the proposed design of the NO_x budget system in Chapter 6. A emissions database assembled for this study is presented in Chapter 7. How the proposed design is consistent with EPA's EIP rules is discussed in Chapter 8, and an analysis of this emissions budget approach versus a command-and-control alternative is given in Chapter 9. The report concludes in Chapter 10 with recommendations to the state air directors. Supporting materials are found in the appendices, including five issue papers prepared early in the project.

2.2 Background of the Feasibility Study

In the Fall of 1993, Northeast States for Coordinated Air Use Management (NESCAUM) received funds from the Environmental Projection Agency's (EPA) Economic Incentive Program (EIP) to support a project evaluating the feasibility of a regional, market-based NO_x emission reduction budget system. The purpose of the project was to develop a report that recommends to the NESCAUM Directors whether a market-based approach to additional NO_x reductions could produce the desired environmental outcome at a lower economic cost in the Northeast.

The project identified that participation of an Ad Hoc Committee would be integral to the development of a viable, effective recommendation to the Directors. The Ad Hoc Committee was envisioned to be comprised of the likely, affected stakeholders of a NO_x budget, including: electric utilities, environmental groups, natural gas companies, state public utility commissions and power pools, located across all eight of the NESCAUM states***. At the first meeting of the Ad Hoc Committee, in November 1993, the original Ad Hoc Committee members (see Table 1) discussed their mission and the preliminary issues that they and the project contractor would need to address. During this meeting, the Committee identified that many of the environmental and economic issues central to the project's goals required the expansion of the geographic coverage of the project to include the mid-Atlantic states. As a result, invitations to participate in the Ad Hoc Committee were extended to representatives of equivalent organizations in the Mid-Atlantic Regional Air Management Association (MARAMA)**** states. Input from this expanded Ad

***NESCAUM member states are: NJ, NY, CT, RI, MA, VT, NH and ME.

****MARAMA member states are: NJ, PA, MD, DE, VA, NC and DC.

Hoc Committee (see Table 2) ensured that the mechanism developed during the project would benefit from the fullest possible exposure to the insights and concerns of those who have highly specialized understandings of the potential effects of a market-based NO_x budget. However, the report itself reflects the synthesis of this input through the perspective of the NESCAUM/MARAMA Emission Trading Workgroup. This workgroup is composed of the appropriate staff member from each state air bureau, and has final responsibility for developing the report's recommendation to the Directors.

TABLE 1

ORIGINAL AD HOC COMMITTEE

Leo Sicuranza; New England Energy Systems
Michael Wax; Institute of Clean Air Companies
Dave Damer; United Illuminating
Robert Russell; Conservation Law Foundation
Mike Flaherty; New England Gas Association
Joel Bluestein; Gas-Based NO_x Control Information Center
Conrad Schneider; Natural Resource Council of Maine
David Hawkins; Natural Resources Defense Council
Rich Sedano; VT Public Utility Commission
Mary Kilmarx; RI Public Utility Commission
Nancy Wittenburg; NJ DEPE
Eric Svenson; Public Service Electric & Gas
William Quinn; New England Cogeneration Association

TABLE 2

EXPANDED AD HOC COMMITTEE

Leo Sicuranza; New England Energy Systems
Michael Wax; Institute of Clean Air Companies
Dave Damer; United Illuminating
Robert Russell; Conservation Law Foundation
Mike Flaherty; New England Gas Association
Joel Bluestein; Gas-Based NO_x Control Information Center
Conrad Schneider; Natural Resource Council of Maine
David Hawkins; Natural Resources Defense Council
Rich Sedano; VT Public Utility Commission
Mary Kilmarx; RI Public Utility Commission
Nancy Wittensburg; NJ DEPE
Eric Svenson; Public Service Electric & Gas
John Howe; New England Cogeneration Association
Roger Caiazza; Niagara Mohawk
Wayne Coste; New England Power Pool
Dwight Atkinson; EPA Office of Policy, Planning and Evaluation
John Bachman; EPA Office of Air Quality Planning and Standards
Jeff West; Metropolitan Edison/GPU
Lynn Ratzell and Tom Keller; Pennsylvania Power and Light
Vince Brisini; Pennsylvania Electric
Nancy Parks; Sierra Club, Pennsylvania
Madison Milhouse; Long Island Lighting
Jim Potts; Potomac Electric Power Company
Debra Sliz; Apco Associates
Jim Cassada; Virginia Power

NESCAUM and MARAMA pursue regional coordination of air quality issues by providing technical and policy support to the Directors and staff of the bureaus of air quality of their respective member states.

To put this report in its proper context, it is important to understand the interrelationship between the on-going work in developing control strategies at the OTC level and at the NESCAUM/MARAMA level. This report represents the second component of a three component process needed to prepare for the implementation of a regional, market-based NO_x budget system.

<u>Component 1.</u> Determination of the level of NO_x reductions that need to be obtained in order to attain the NAAQS for ozone throughout the OTR within the timeframes prescribed in the CAAA.

<u>Component 2.</u> The crafting of the mechanism for achieving the required reductions.

<u>Component 3.</u> The development of the full technical detail needed for the implementation of the mechanism, including the development of an interface between the new program and all relevant existing state and federal programs.

The first component is being addressed by the members of the OTC Stationary/Area Source Committee. This Committee has prepared recommendations to the full OTC which set forth proposed target levels for Phase II NO_x reductions (Component 1). This report will be forwarded to the full OTC as well so that it may consider adopting the recommended NO_x emissions budget system as the mechanism for achieving the reductions (Component 2). If the recommendations that have emerged from these first two components gain acceptance, the work on the technical detail required for implementation (Component 3) will commence.

2.3 **Study Assumptions**

As described in Section 2.2 (Background of the Feasibility Study), this project represents one of three components that are necessary groundwork for the implementation of a NO_x budget system to achieve Phase II NO_x reductions. As a result, the scope of the issues examined as part of this study have been limited to those that pertain to the mechanism for achieving emission reductions. It is a fundamental presumption of this study that this mechanism will be considered for use as a means of achieving the final NO_x reduction targets determined by the OTC.

Additionally, in preparing this study, in those cases in which information was required but complete information was not available, assumptions were made in order to allow the study to advance. The study's major <u>assumptions</u> are as follows:

1. It seems certain that additional controls beyond NO_x RACT in 1995 will be necessary from large sources of NO_x for states to be able to demonstrate attainment in their State Implementation Plans (SIP's). For the NESCAUM/MARAMA region, application of NO_x RACT in 1995 will result in a 30% or more reduction in NO_x emissions from 1990 baseline emission rates. (SIP's will also include NO_x and VOC control measures for other stationary and mobile sources. To the extent NO_x reductions are not made by the sources included in the NO_x budget system, greater reductions will have to be obtained from other sources for attainment to be demonstrated.)

   It is anticipated that regional air quality modeling efforts will demonstrate that the additional controls on major stationary sources will need to provide 60% to 80% reductions from the 1990 baseline emissions for attainment to be reached.

2. It is assumed that the goal of the NO_x budget program to reduce NO_x levels <u>overall</u> during the ozone season, will also help to reduce ozone levels on <u>peak days</u>. The program presented here provides electric generators with the incentive to control baseload units more than peaking units.

3. An emission budget is a cap on mass emissions over certain time periods, e.g., a day, an ozone season, or a year. Thus, an emission budget is expressed in tons per day (or per season or per year). Since an emission rate limit (e.g., lb/MMBtu), by itself, does not establish a limit on total mass emissions,

it is assumed that an emissions budget instead of a rate limit is needed to attain the ozone standard.

4. The emission budget system design must be based on reasonable assumptions that are within technical and economic feasibility. For example, the status of control technologies (technical feasibility and cost effectiveness) may affect the technical rationale for the selection of an emission budget. Any given stationary source, such as a utility power generating station, must consider the feasibility or practical impediments to applicable retrofit controls. How readily emissions from sources can be controlled beyond post RACT levels depends on such factors as:

   - The type of controls used for RACT compliance
   - The viability of fuel switching
   - Commercial availability and cost of controls beyond RACT
   - Demonstration status and acceptance of controls by industry
   - The characteristics of the specific equipment

5. Though it is very important to have a trading component in the NO_x budget design, it is also important to recognize that interstate and interutility trading of allowances will represent a small fraction of the overall NO_x budget. It is assumed this fraction will not exceed 5%. However, intra-source trading (i.e., averaging among sources owned by the same entity) is expected to play a larger role.

3.0 PRINCIPLES

The goal of this study is to recommend to the states a feasible, regional, market-based mechanism for reducing NO_x to the level(s) set by the OTC. To this end, the project has been guided by the following principles:

1. To promote innovative, cost-effective approaches to NO_x emissions reduction by stationary sources in the OTR;

2. To provide stationary sources in the OTR more flexibility in meeting post-RACT NO_x control requirements including options such as energy conservation, and seasonal fuel switching;

3. To increase the certainty of NO_x emission reductions for the OTR states and in so doing assist them in achieving ozone attainment.

4. To encourage some sources to make reductions in NO_x emissions earlier than they would have otherwise.

5. To satisfy EPA's published guidance for a discretionary Economic Incentive Program (EIP),[7] which is the most flexible mechanism available for implementing an interstate control program. Among the required program elements are the following:

   a. The NO_x budget program shall be state and federally enforceable.

   b. The NO_x budget program shall be nondiscriminatory with respect to interstate commerce.

   c. The NO_x budget program shall be consistent with: the timely attainment of the NAAQS for ozone; all applicable RFP and visibility requirements; applicable PSD increments; and all other applicable requirements of the Clean Air Act.

d. The NO_x budget program shall be designed to ensure that in nonattainment areas credit may be taken in attainment and RFP demonstrations. To accomplish this, the program must include the following provisions:

   (1) The effects of the program must be quantifiable;

   (2) The effects of the program must be permanent over the duration of the program; and

   (3) The credit taken must be limited to that which is surplus to other SIP-credited requirements.

e. EPA rules advise that discretionary EIP should also provide "environmental benefits". EPA includes in its definition of program features that provide such benefits "the adoption of emission caps"[7]. Additionally, the NO_x budget system may provide further "environmental benefits" through collateral reductions in other pollutant emissions.

4.0 DEFINITIONS

The following **definitions** are used in this report and summarized alphabetically below.

Affected Sources are the group of stationary sources whose NO_x emissions will be regulated by the NO_x budget system.

Allowance Trading is the mechanism for reducing overall compliance costs within the Budget Zone by allowing one Affected Source (with lower marginal control costs) to over-control and trade excess NO_x Allowances to another Affected Source (with higher marginal control costs) that under-controls. Allowances will be marketable emission authorizations within Budget Zone, meaning they may be bought, sold or traded for use during a designated year to any other source within the Budget Zone. Trading between Budget Zones will be subject to minor restrictions (see Section 5.10).

Banking is a mechanism allowing the retention of unused NO_x Allowances for future use in another year. Banking is considered in this study (see Section 5.11).

Budget Zone is the geographic area in which the NO_x budget system applies. There may be multiple Budget Zones with separate NO_x budgets.

Control Period is the time period during which the NO_x budget system will apply.

Emission Reduction Credit is a unit of NO_x emission reduction from a source outside of the NO_x budget system that is documented to be real, surplus, enforceable, permanent and quantifiable.

Moth-Balled Unit is an Affected Source that, while permitted, rarely operates.

New Sources are Affected Sources that begin normal operation after May 1, 1994.

NO_x Allowances are the currency of the NO_x budget system. They will be allocated anew each year to Affected Sources and will authorize an affected source to emit 1 ton/ozone season during a particular year. Allowances will not confer property rights on the facility owners holding them. Eligible uses of NO_x Allowances will be: (1) for the NO_x budget system, to satisfy the requirement that sufficient allowances be held during an ozone season equal to or greater than the actual NO_x emissions, and (2) to satisfy other Clean Air Act requirements such as emission offsets or netting, subject to restrictions in existing EPA regulations and policies. The allowance trading program is not directly related to New Source Review (NSR) though it may assist New Sources in complying with

NSR. A full discussion of using allowances to satisfy emission offset requirements is given in Section 5.8.

NO_x Budget is the regulatory limit on the total tons of NO_x released into the atmosphere by Affected Sources within the Budget Zone.

Number of Steps refers to the number of downward adjustments in the NO_x budget over time to achieve a desired NO_x emission reduction goal.

Ozone Season is the five month period from May 1 through September 30.

Shutdown Units are existing Affected Sources that cease operation permanently after the NO_x budget system begins.

5.0 PARAMETERS OF THE NO_x EMISSIONS BUDGET SYSTEM

The essential parameters of the NO_x budget system are listed in this section. The viable options for each parameter are listed. The advantages and disadvantages of each option are discussed and the recommended option is identified.

5.1 Affected Sources

This parameter defines the types of sources to be included in the NO_x budget system. The options are:

1. Each fuel combustion unit at all electric generating facilities, utility or Non-Utility Generator (NUG);
2. All electric generating facility fuel combustion units (utility or NUG) with a rated output of 15 MW or more, plus all industrial boilers with a heat input of 250 MMBtu/hr or more.
3. All fuel combustion units located at major facilities, i.e., those required to hold a Title V operating permit. These are facilities having the potential to emit (25 to 100 tons per year NO_x depending on their location).

The options for source types evolved from Issue Paper #5 (see Appendix A); they start with a relatively small group of the largest NO_x sources and become more inclusive. Administration of the budget will be easiest for the smallest number of sources (Option 1), while the market will work best at lowering control costs if trading is possible between the largest number of sources (Option 3). For enforcement, Continuous Emissions Monitoring Systems (CEMS) will be preferred at all Affected Sources and it may be difficult to impose this cost on all the sources in Option 3. Based on these reasons and the further discussion presented in Issue Paper #5, Option 2 is recommended. The States could expand the defined categories of Affected Sources after the NO_x budget system is in operation.

In Option 2, the 15 MW threshold for electric generating units was set to exclude a number of small sources such as cogeneration units at institutions and landfill gas systems. This threshold was originally set at 25 MW, approximately equal to the 250 MMBtu/hr threshold for industrial boilers. Figure 2, which is based on the EPA emissions database presented in Section 7.0, suggests that the electric generating units below 25 MW constitute only 1.4% of the total stationary source NO_x inventory. However, further analysis of the EPA emissions database reveals that simple cycle gas turbine units used for electric generation ("peaking units") are substantially missing from the EPA database. Many of these are sized in the range of 15 to 25 MW rated output. For example, the EPA emissions database lists only 40 MW of gas turbine capacity in this size range for all of New England whereas NEPOOL statistics[12] confirm 779 MW of capacity in such units today. As a result, electric generating units below 25 MW probably constitute closer to 3% or more of total NO_x inventory. Since these peaking units may contribute to emissions on hot summer days that are prone to ozone exceedances, the recommended threshold has been lowered to 15 MW. Figure 2 shows that Option 2 will put at least 93% of the stationary source NO_x emissions on a peak ozone day into the NO_x budget system.

5.2 Control Period

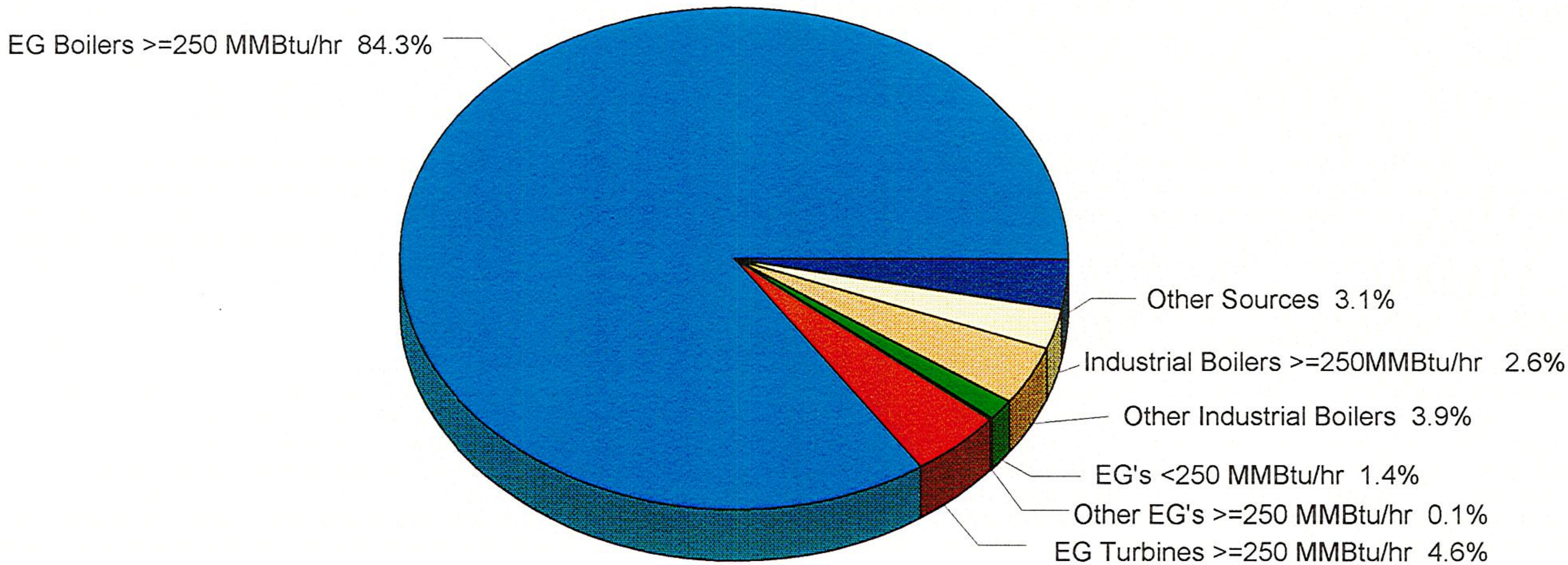
This parameter defines the portion of the year during which NO_x emissions will be subject to the post-RACT controls in the NO_x budget program. The options are:

1. The full calendar year.
2. The ozone season: the five-month period from May 1 to September 30.
3. Both of the above.

FIGURE 2

CLASSIFICATIONS OF 1990 STATIONARY SOURCE* NOx EMISSIONS IN THE OTR FOR THE PEAK OZONE DAY

BY SOURCE TYPE (lbs/day)



* Includes sources with actual 1990 NOx emissions of 25 TPY or more

EG = Electric Generators

An annual control period (Option 1) follows the control approach used in RACT. Since ozone is not a year-round problem in the OTR, an annual budget would require sources to pay for NO_x reductions during the seven-month period outside the ozone season when no benefit in terms of reduced ozone levels would occur. This is not a cost-effective approach to ozone control. In addition, the Clean Air Act does not require annual NO_x reductions beyond RACT for major stationary sources.

The primary goal of the NO_x budget program is to aid ozone attainment and to that end a seasonal control period should be preferred, both because it ensures the reductions occur at the right time of year and because it provides sources more flexibility and offers the possibility of lower control costs by making fuel switching for the ozone season a viable option.

Some study participants, concerned about reducing nitrate deposition in the region have argued that the control period should be a full calendar year. However, a seasonal control period (Option 2) will automatically produce substantial annual reductions because RACT limits place a ceiling on NO_x emissions during non-ozone season months and substantial beyond-RACT NO_x reductions will occur during the ozone season. Further, a seasonal control period will not result in NO_x emissions being shifted to non-ozone season months for two reasons:

- The principal sources being controlled, power generating units, base their operation on daily electrical demand and economic dispatch orders from power pools. Excess power can not be generated in say January, stored for six months and then sold to customers in July. Thus the operations (and fuel consumed) by these sources will not be shifted from the ozone season to other months. The same argument applies to large industrial boilers which are run in response to daily steam demand at a facility.

- Emissions rates for the Affected Sources are already subject to NO_x emission rate limits on an annual basis as a result of NO_x RACT. These sources can not increase their emission rates in non-ozone season months above the RACT limits, and NO_x budget will effectively lower emission rates during the ozone season.

Option 3, seasonal and annual budgets, provides controls during both periods but would add administrative burdens to the program, complicate allowance trading and is unnecessary for the reasons stated above.

Based on the above discussion and the further discussion presented in Issue Paper #4, Option 2 is recommended. That is, each Affected Source will comply with a seasonal budget and allowances will be issued in units of tons per 5-month ozone season. Allowances will be allocated to Affected Sources before the start of each ozone season so that sources can fulfill the obligations discussed in the next section.

5.3 Daily Limit

In order for a state to take credit for the benefits of the NO_x budget system in its SIP, it will have to demonstrate to EPA what reductions in 24-hour NO_x emissions will occur during the ozone season. This parameter defines whether a facility's emissions will be regulated on a daily basis, and if so how such a 24-hour budget is to be enforced. The recommended choices are:

1. A seasonal emission budget with no 24-hour emission limit. (Daily emission reductions will be estimated by the state; credit will be adjusted by an uncertainty factor, and the state will perform annual audit and reconciliation of the projected 24-hour reductions.)

2. A facility's daily emissions must comply with a 24-hour budget equal to 120% of the seasonal budget expressed on a daily average basis.

3. Other 24-hour limits.

    a. A facility's daily emissions must comply with a 24-hour budget equal to the seasonal budget expressed on a daily average basis (the seasonal budget divided by 153 days).

    b. A 5-day rolling average of a facility's emissions must comply with a 24-hour budget equal to the seasonal budget expressed on a daily average basis.

c. A facility's average operational day emissions must comply with a 24-hour budget equal to the seasonal budget expressed on a daily average basis.

d. A facility's daily emissions must comply with some 24-hour budget but only on those day's forecast to have high ozone levels.

Discussions with the power pools indicate that on a peak demand day in the summer, typically those with high temperatures, practically all electric generating units are in operation. Thus, the major NO_x sources are likely to have higher emissions on ozone episode days, which also are associated with high ambient temperatures. A strategy that only tries to reduce the ozone peaks would logically include a 24-hour emissions limit. Adding any type of 24-hour limit or budget, however, will substantially restrict the flexibility offered by a seasonal NO_x budget and reduce the number of cost-effective control options available to Affected Sources. A 24-hour limit would encourage electric generating facilities to control peaking units first and baseload units last, whereas a program with only a seasonal budget will encourage controls on baseload units first.

The states recognize that the NO_x budget program will not be the sale ozone control strategy, i.e., it can not by itself enable the ozone standard to be attained. Given that peaking units only represent a few percent of the electric generating sector's NO_x emissions on a peak ozone day (see Section 5.1) and that the majority of the emissions are from baseload units, it is concluded that the value of the NO_x budget system can be maximized by reducing overall NO_x levels throughout the ozone season, not to focus on controls for peak days. This conclusion is stated as a Project Assumption (number 2) in Section 2.3. In addition, utility representatives have argued that a seasonal averaging period will make allowance trading more administratively viable, thus facilitating cost-effective program implementation. Thus, the recommended choice for Daily Limit is Option 1, no 24-hour emissions limit. Selecting this option will make the seasonal budget work most effectively.

This option is, however, recommended conditionally. The credit that can be given for any control measure in a SIP is dependent upon its ability to assure emission reductions on a typical summer day. As states will need to rely on the NO_x emissions budget system in the modeling performed for their attainment demonstrations in their SIP's, the effectiveness of a NO_x emissions budget program with a seasonal averaging period in reducing NO_x emissions on peak ozone days will need to be demonstrated to the satisfaction of the states and U.S. EPA. (See Section 6.2 for a discussion of technical issues to be taken up in the future). A statistical showing will need to be made that a seasonal budget is consistent with the RFP and attainment demonstrations in states' SIP's. The information on which such a demonstration would be based would need to be provided by utilities. If a demonstration that adequate emissions reductions would be realized on peak ozone days is not or can not be made, one of the other options would need to be selected.

To prepare such a demonstration, a methodology will be required for projecting the maximum 24-hour emissions during the ozone season, as required by EPA's EIP rules.[7] In the SIP attainment demonstration this projection must be adjusted by a "rule compliance factor" and a "program uncertainty factor". (This type of adjustment to SIP credit is currently done for traditional regulations using a "rule effectiveness factor"). As a result, the SIP credit a state will be able to claim will be less than that projected by the NO_x budget system. The NO_x emission budget system will also need to contain audit procedures designed to evaluate program implementation and track program results in terms of actual daily emissions. The program must also include a reconciliation procedure that specifies, should the audit indicate that actual daily emissions exceed the levels projected in the demonstration included in the SIP, then changes in the program will take effect no later than the beginning of the next ozone season. It is recognized that EPA will scrutinize this aspect of the program and that they will need to approve the projection, audit and reconciliation procedures.

With this in mind, the following procedure is recommended. Following each ozone season, facility owners will be required to submit reports based on 24-hour Continuous Emissions Monitoring Systems (CEMS) data for each Affected Source after each ozone season; these reports will: (1) indicate the actual 24-hour NO_x emissions for each day of the ozone season, and (2) compare the actual 24-hour emission reductions with the SIP credited reductions (i.e., the projected reductions adjusted for rule compliance and program uncertainty factors). If the actual 24-hour NO_x reductions are less than those credited, then the following action is recommended to be taken automatically to makeup for the shortfall: the NO_x Allowances allocated to all sources in the state having the shortfall will be reduced accordingly for the next and all subsequent ozone seasons. States may also specify other contingency measures in their SIP's that could be put into effect other than an automatic downward adjustment in the NO_x Allowances.

While Option 1 is preferred, the states realize that EPA may not approve the procedure described above. In that case, it is useful to discuss the type of 24-hour budget that might be adopted if EPA does not allow the NO_x budget system to be as flexible as it is conceived here. All of the 24-hour budget options discussed below are all tied to the value of the seasonal budget so that only one set of allowances would need to be used in the program.

Option 2 is a 24-hour budget that would give Affected Sources some flexibility, provide the assurances that the states and EPA need on 24-hour NO_x emissions, and avoid the problems of the other options stated below. For these reasons, Option 2 is preferred as a fall back in the event EPA does not approve the use of Option 1. The selection of 120% as the scaling factor is somewhat arbitrary. If the factor is higher, and sources are given more flexibility, then the regional NO_x budget would have to be correspondingly lower to yield the same reductions in ozone day NO_x emissions for the states to claim in their SIP's. There is therefore a tradeoff between flexibility and the tightness of the NO_x budget. The choice of 120% is an attempt to balance those factors.

Of the other 24-hour budget choices, Option 3a is the least flexible for Affected Sources since it assumes no variation in daily emissions throughout the ozone season. Option 3b, while more flexible, would be cumbersome to administer and enforce. Option 3c is not preferred since it might tempt facility owners to operate equipment for short periods of time on summer days to influence the calculated emissions average. Option 3d would entail forecasting ozone episode days in advance and to be effective this would have to be done on a regional basis. Discussions with the states indicate this may be impractical, and discussions with a PUC indicate there is insufficient flexibility in utility dispatch to allow intermittent controls. Option 3d is a good concept because it would apply daily controls only when needed, but it would need to be studied further to show it could be implemented.

In summary, Option 1 is preferred, and Option 2 is the fall back choice if EPA disapproves of this approach in the EIP.

5.4 NO_x Allowances

Until the first step down is taken in the emissions budget (see Section 5.6), the total value of any regional emissions budget would be equal to the total emissions collectively allowed for the Affected Sources under the states' RACT rules for NO_x emissions. Utilizing recommendations prepared by its Stationary/Area Source Committee, the OTC is currently making determinations as to the NO_x emission reductions that should be achieved by 1999 and 2003 in a regional NO_x program. Under a NO_x emissions budget system, the total value of the future emissions budget would decline, so as to ensure that OTC established reduction goals would be achieved.

In any given year the total value of the emissions budget would be divided into an equivalent number of emission allowances. Each emission allowance would have a mass emission value, such as one ton of NO_x per ozone season. The NO_x Allowances will be allocated to Affected Sources. In any given year, the proportional share of allowances to be allocated to a source will be determined by the product of two parameters:

$$\text{NO}_x \text{ Allowances} = 0.005 \text{ (ton/lb)} \times \text{Baseline Activity Measure} \times \text{Budget Emission Rate}$$

where Baseline Activity Measure and Budget Emission Rate are defined in the next two sections.

The Baseline Activity Measure will be defined once for a given source and will not vary from year to year. The Budget Emission Rate will be set for each future year by the states who administer the NO_x budget to achieve a desired regional total of NO_x Allowances. That is, the states will first determine the total NO_x budget, then knowing what the total Baseline Activity Measures sum to, they will set the Budget Emission Rate accordingly.

If for example, the Baseline Activity Measure was the actual heat input to a combustion unit during the ozone season of the base year (MMBtu/5 months), then the Budget Emission Rate would be expressed in units of lb/MMBtu to yield a NO_x Allowance in units of tons per 5 months for the unit. Depending on how the Budget Emission Rate is defined, the resulting NO_x Allowances will be allocated on either a fuel independent or fuel specific basis. An affected facility may use the allowances allocated to it as authorizations for emissions from any source on the promises that is included in the NO_x emissions budget system. The program will not impose the Budget Emission Rate on individual units as a separate regulatory limit.

The NO_x Budget in a Budget Zone is defined by the sum of the NO_x Allowances for all Affected Sources in that region. The actual value of the NO_x Budget is not established in this study and will be set by states in the OTR when the program is implemented. The budget system outlined in this study is designed to be effective regardless of the value of the NO_x Budget.

An alternative allocation scheme was also considered where the NO_x Allowances for a Budget Zone would first be allocated to the component states, and then states would re-allocate these allowances to individual Affected Sources. That approach is not recommended since it would produce inconsistent control requirements within a Budget Zone, and changing state rules would make it very difficult for a utility operating in more than one state to do proper long range planning.

5.4.1 Baseline Activity Measure

This parameter defines part of the method by which allowances in each year will be allocated. The recommended choices are:

1. The maximum continuous power rating (MW or lb/hr of steam) of a fuel combustion unit.
2. The actual power production (MWh or lb steam) of a fuel combustion unit during the ozone season in 1994, or if 1994 is not representative, then the average for the ozone seasons in the period 1990-1993 that the source operated.
3. The maximum 24-hour heat input (MMBtu) actually used in a fuel combustion unit during the ozone season in 1994, or if 1994 is not representative, then the average for the ozone seasons in the period 1990-1993 that the source operated.
4. The actual heat input (MMBtu) to a fuel combustion unit during the ozone season in 1994, or if 1994 is not representative, then the average for the ozone seasons in the period 1990-1993 that the source operated.

1994 is used as the base year (and the average of 1990 through 1993 as a representative alternative) in Options 2 through 4 to avoid creating incentives for sources to "plan" baseline emissions.

The options for Baseline Activity Measure are maximum power output (Options 1 and 2) or actual heat input (Options 3 and 4) for a fuel combustion unit. Using power output will provide direct incentives for energy efficiency by allocating more allowances to the most fuel efficient units. The measure of power output, however, varies between generators, boilers and other sources and it may be difficult to equitably allocate allowances. While heat input as a choice does not directly reward energy efficiency, it does provide a common measure for all combustion units and may be the easiest choice to administer. Also, the use of mass budgets (instead of emission rates) in the NO_x budget program does encourage energy efficiency. Thus, Options 3 and 4 are preferred. There is a linkage regarding averaging time between the choices for Daily Limit and Baseline Activity Measure. Assuming Option 1 is selected for Daily Limit and the program focuses on seasonal emissions, the most appropriate choice here is Option 4, the actual heat input during the ozone season in the base year.

New Sources, those that begin normal operation after May 1, 1994, will not have a full ozone season operating history from which to determine their actual heat input. The Baseline Activity Measure for a New Source will be based on its design heat input rate for the ozone season, adjusted by any operational restrictions in the New Source permit. This approach guarantees that a newly permitted power generating unit (which will be subject to stringent BACT or LAER emission control standards) will receive adequate allowances to operate within its permitted limits. This policy will clearly encourage repowering, and the shift to newer, cleaner power units. Such an incentive directly supports the Principle of promoting NO_x reductions to achieve ozone attainment.

5.4.2 Budget Emission Rate

The Budget Emission Rate is used in conjunction with Baseline Activity Measure to determine how many NO_x Allowances will be allocated to each Affected Source in a Budget Zone. The NO_x budget system will <u>not</u> be imposing this rate on individual sources as a separate regulatory limit. The Budget Emission Rate will decline over time to ensure that the total number of allowances allocated is consistent with the declining emissions budget level. For this parameter, the recommended options are:

1. A fuel specific emission rate.

2. A fuel independent emission rate.

3. An emission rate that begins fuel specific and becomes fuel independent within six years.

Fuel specific allocation based on historical emissions gives everyone less allowances than they need under a declining budget system, forcing all units (clean and dirty) to further reduce emissions either directly or through the purchase of allowances. Higher NO_x emitters will view this as proportional control. Lower NO_x emitters will view this as the cleanest sources subsidizing the control costs of the dirtiest sources and requiring them (the lower NO_x emitters) to pay twice for NO_x controls: once in the initial design/construction of a facility and a second-time in response to the regional NO_x budget. Fuel specific allocation imposes the same percentage control on very low and very high emitters and generally cleaner sources will have higher dollar/ton control costs (the marginal cost of control increases as emissions decrease). Fuel independent allocation of allowances provides all units of a similar size equal emission authorizations and is the preferred approach in the NO_x budget program.

A fuel independent limit would, however, cause the highest emitters to be subject to large reductions early in the NO_x budget program. To provide these sources with more time for planning and for carrying out the modification or repowering of units, it seems reasonable to phase in the fuel independent emission rate. Thus, Option 3 is recommended. It should be noted that any utility usually uses a mix of different fuels (coal, oil, gas) and moving towards a fuel independent limit as the basis for allocating allowances does <u>not</u> force the utility to meet a single emissions rate on all generating units. The utility will probably plan to emit more from its coal-fired units and less from its gas-fired units, so as to achieve total NO_x emissions in line with the total allowances in its possession. Thus, Option 3 is <u>not</u> the same as a command-and-control fuel independent NO_x regulation. Allowance trading both internal and external to a facility will allow its owners wide flexibility in deciding which sources to control.

An illustration of how the phase-in of a fuel independent limit might look is shown in Figure 3. An illustration of how an alternative set of fuel dependent limits might be implemented is shown in Figure 4. The Budget Emission Rates shown in these figures are for illustration only and do not represent recommended values.

With two or three Budget Zones, the states could decide to use different approaches in each. While this report recommends Option 3 as being preferred, the lack of unanimity on the issue suggests that the states and OTC will decide which option is best for the Budget Emission Rate used in allocating NO_x Allowances at a later date.

As discussed further in Section 5.7, for New Sources that begin normal operation after May 1, 1994, the lesser of their permit NO_x limit or the Budget Emission Rate for existing sources will be used in calculating available NO_x Allowances. Such an incentive directly supports the principle of promoting NO_x reductions to achieve ozone attainment.

5.5 Target Years

The target years for the NO_x emissions budget system will be consistent with the NO_x emission reduction goals set by the OTC.

5.5.1 Target Program Start-Date

The earliest year for which the implementation of the NO_x emissions budget program is theoretically feasible is 1996, and probably the earliest year for which implementation is practical is 1997. Thus the recommended Target Program Start-Date for when sources would be subject to the NO_x budget is the ozone season for 1997. EPA review of the state rules would need to be done in parallel with the final development of the program, so that if state rules are adopted by 1996 EPA can approve the program prior to the 1997 ozone season.

FIGURE 3

EXAMPLE OF A HYPOTHETICAL PHASED-IN FUEL INDEPENDENT NOx BUDGET EMISSION RATE

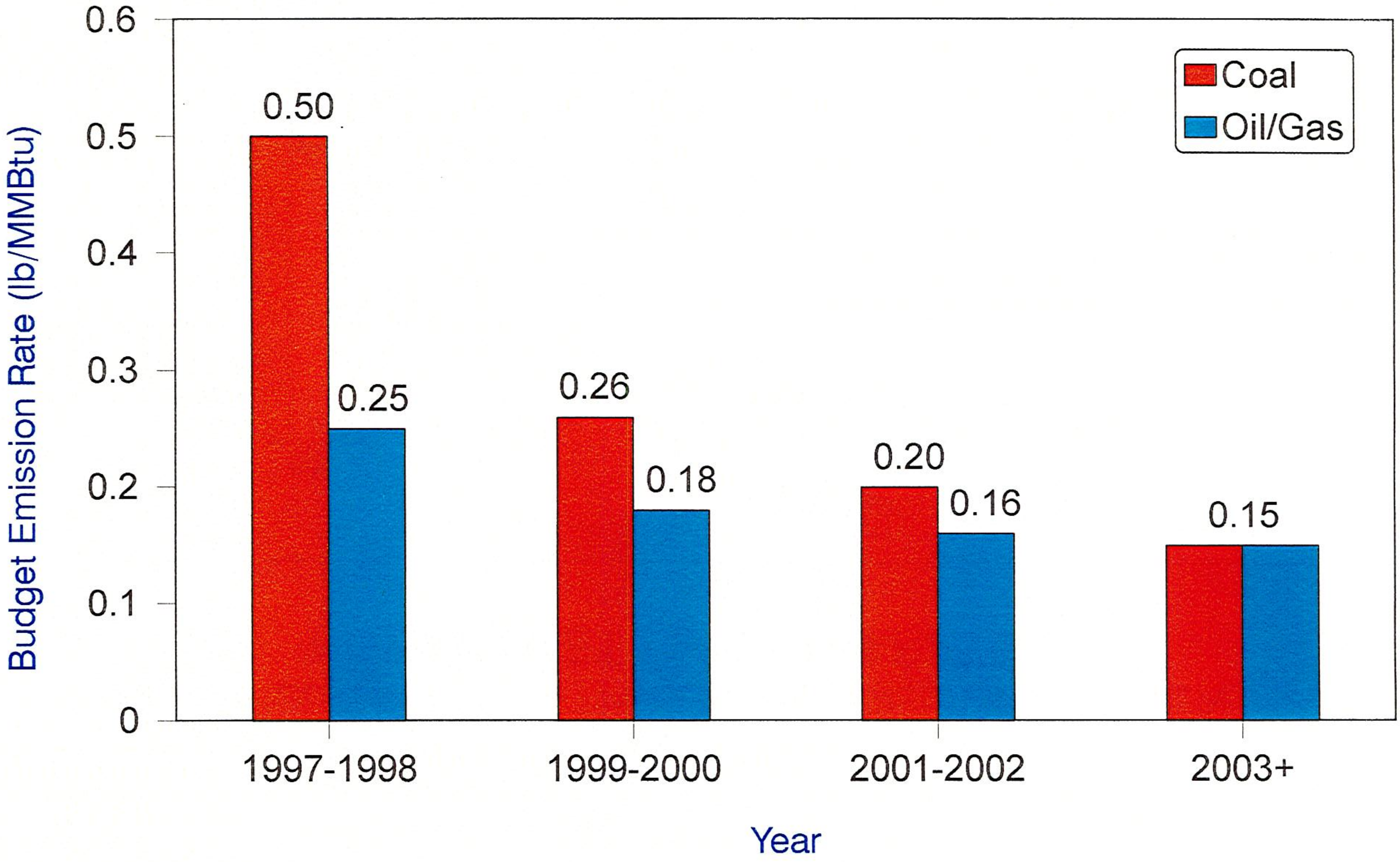
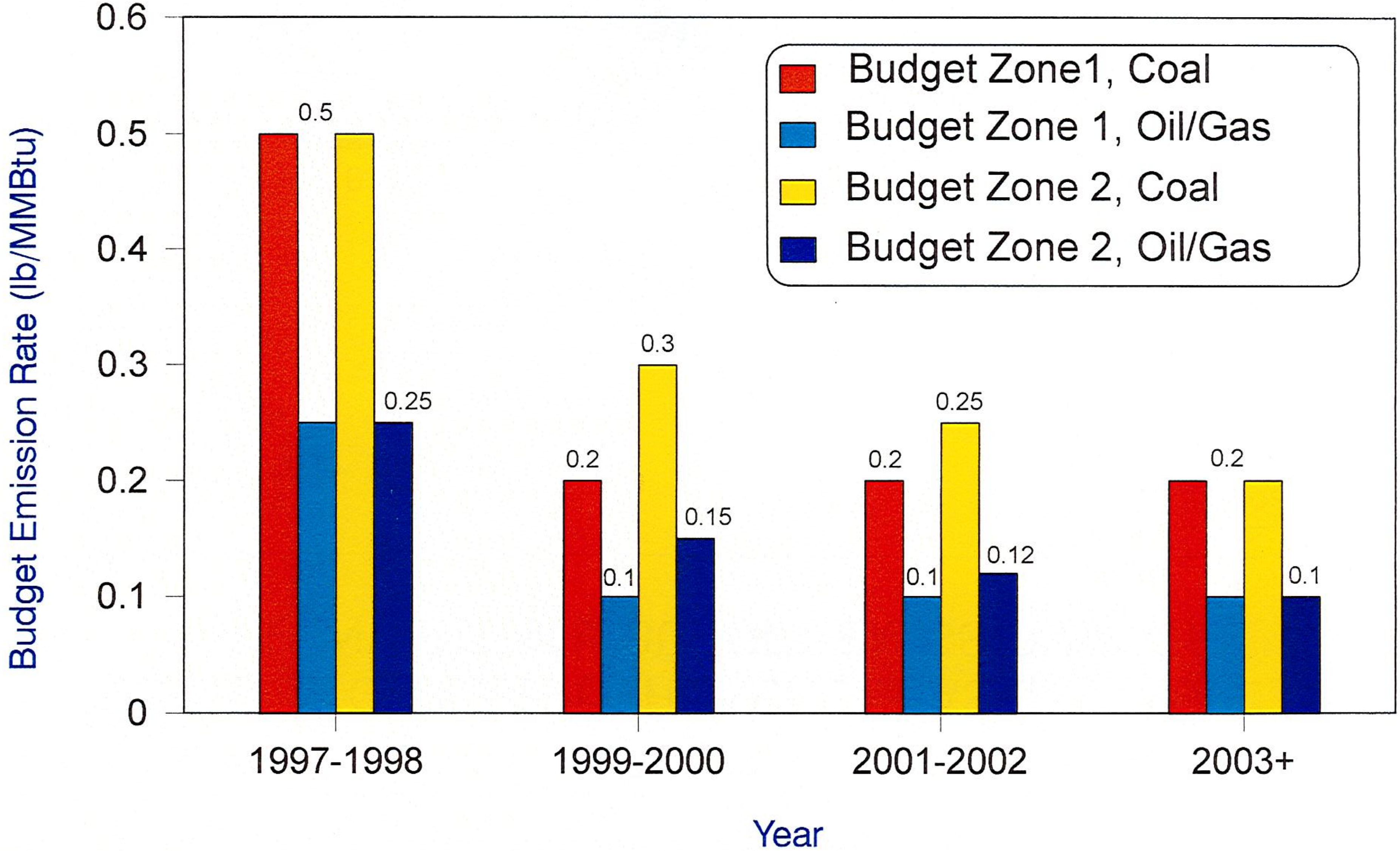


FIGURE 4

EXAMPLE OF HYPOTHETICAL FUEL DEPENDENT NOx BUDGET EMISSION RATES



Otherwise, states would need to proceed with implementation while EPA is completing the process of approving the program in full.

5.5.2 Target End-Date

The Target End-Date is the date by which the budgets will be decreased to their lowest level. The recommended options are:

1. 1999 (Serious area attainment date);
2. 2003 (consistent with OTC recommendations).

The End-Date for the budgets is a difficult choice since the Clean Air Act sets deadlines as late as 2007 for the severe nonattainment areas and much earlier deadlines (1993, 1996 or 1999) for the marginal to serious areas some of which are downwind in the OTC. 1996 is not given as an option since a program could not be in place, control choices made and implemented by sources in that short a time. The next attainment deadline in the Act is 1999 and this is one choice. The alternative of 2003 is consistent with OTC recommendations and will allow more time for planning and reductions within the OTR, but it will delay the full benefits of a NO_x budget program for those areas with attainment dates before 2003. Those areas will have to rely on other measures to ensure attainment before 2003.

While a NO_x emission budget system is not the only ozone attainment strategy to be included in SIP's, it will be viewed as a substantial measure for regionwide reductions. Thus, proper long-term planning is important. With a 2003 Target End-Date, it is important for the states to plan on substantial reductions by 1999 as part of the overall plan. EPA recommended at an August, 1994 meeting of the OTC Stationary/Area Source Committee that 1999 NO_x reductions be targeted at 80% of the final reduction that states will need for ozone attainment. Given the absence of complete modeling results, it may be necessary to make a "mid-course correction" in SIP attainment planning in the future once the modeling data are available. Option 2 will provide more flexibility than having 1999 as the final target year would allow. Yet 2003 is early enough for Severe-15 non-attainment areas to obtain the three year's of data they will need to make an attainment demonstration in 2005, in accordance with the schedule in the Clean Air Act. For the reasons stated above, Option 2 is preferred. The final choice should be consistent with final OTC recommendations. The choice of End-Date does not affect the NO_x budget mechanism.

5.6 Number of Steps

This parameter defines the number of downward steps that will be taken in the total NO_x budget from the Target Program Start-Date to End-Date. The options are:

1. One (a single step);
2. Annual steps;
3. Periodic steps every two or three years.

Annual steps down provide the benefit of guaranteed early and interim reductions before the final budget but may complicate planning by sources. A single step down will give sources flexibility, but with trading of allowances flexibility is also inherent in all the other choices. A step every two or three years is consistent with the mandate on the states to submit RFP demonstrations every three years and would give sources more flexibility. Option 3 is recommended.

5.7 New Sources

This parameter defines how individual emission units***** that begin normal operation after May 1, 1994 will obtain NO_x Allowances so that they may legally operate. There are three recommended options that preserve the concept of a NO_x budget:

1. Buy allowances only from existing sources. No set-side account.

2. Purchase allowances at an auction from a small set-aside account (e.g., 2%). The set-aside account will be increased with time as needed. New Sources will be guaranteed the opportunity to buy enough allowances for full operation at their permitted emission rates.

3. Receive allowances from a small 2% set-aside account (e.g., 2%). The set-aside account will be increased with time if needed. New Sources will be granted enough allowances for full operation.

There must be a mechanism for allowing new power generating sources to obtain NO_x Allowances without compromising the NO_x budget. Since New Sources will have been through BACT or LAER, their NO_x emissions per unit of energy production will be very low compared to the existing Affected Sources. The program should be designed to encourage the development of New Sources (repowering) and not to discourage their operation.

Option 1 is the simplest approach. It would let the market re-allocate allowances from those sources in existence at the beginning of the program to New Sources willing to pay the market price. It would, however, give existing sources that refuse to sell allowances tremendous power to exclude competition. For that reason, Option 1 is inequitable and Options 2 or 3 are preferred. Under either of these, a New Source would still have the option of

*****Under state and federal permitting regulations, a new electric generating unit or a substantial reconstruction of an existing unit would be termed a "modification" if it was located at an existing facility. The term New Sources used in this section and elsewhere throughout this report is intended to mean such emission units, as well as new units at new facilities.

purchasing allowances from an existing source, it just would not be the only option. Options 2 and 3, do involve added administrative responsibility for the states or a regional organization.

If the set-aside account was set at 2%, it would be created by only allocating to each existing source 98% of the allowances planned each year. Given the relatively low NO_x emission rates of New Sources subject to BACT or LAER, 2% should be adequate to provide for re-powering and New Source growth through the first ten years of the NO_x budget system. Two percent of the NO_x inventory for Affected Sources in 1995 (after RACT) is expected to be about 16,000 tons per year or roughly 4,000 MW of new baseload generating capacity (at an emission rate of 0.1 lb NO_x per MMBtu). Current projections from the New York and New England Pools, covering about half the OTR, show the need for about 2,000 MW of new power generating capacity by the year 2009.[12] In Option 2, new Affected Sources will be able to buy enough allowances from the set aside account at an auction for full operation. This will ensure any new power generating unit could obtain financing for construction since the means of obtaining allowances each year at a market price would be guaranteed.

Option 3 also involves a set-aside account but here the allowances would be given to new Affected Source at no cost. Since these allowances can only be made available if existing sources spend extra money on NO_x control, it seems reasonable to ask that New Sources pay for such allowances. Thus Option 2 is preferred.

The issue of whether utilities that decide to repower at an existing site should have access to the set aside account was examined. In such instances the utility should have ample allowances available through shutdown to cover the needs of a new unit. While restricting the set aside account to only "new sites" sounds fair at first glance, it introduces an undesirable distinction between growth at new sites and growth at existing facilities. A utility that repowers actually will have a choice between using allowances from the shutdown unit or buying guaranteed allowances for a new unit. If they have ample shutdown allowances, they will naturally use those since they are already in hand, and they will decline to buy the guaranteed ones. For these reasons, the set aside account should be made available to all New Sources in the Budget Zone.

5.8 Emission Offsets

New and modified sources in the OTR will also in some cases need to obtain emission offsets under EPA's Title I regulations. Emission offsets are a separate requirement and are tied to the increase in annual allowable emissions resulting from the New Source. Sources needing emission offsets can currently obtain them several ways: internal netting via shutdown of old equipment; through intrastate trading of emission reductions (e.g., shutdown or control of another facility, or mobile source reductions); and through interstate trading of emission reductions via a SIP revision. The problem of non-availability of offsets is most acute for the attainment portions of the OTR and small states. It is envisioned that NO_x Allowances could also be used to satisfy emission offset requirements, subject to EPA policy restrictions (see Issue Paper #2). Thus, the NO_x budget program may be able to help facilitate economic growth in the OTR while providing a mechanism for cost-effective NO_x control.

Using the set-aside account as the source for emission offsets only works for New Sources in attainment areas because Section 173 of the Clean Air Act places no limits on where emission reductions can come from for sources needing emission offsets in those areas. New Sources locating in non-attainment areas that need emission offsets still face the restrictions of Section 173. For example, a set aside account for an area encompassing the coastal corridor would garnish allowances from sources in nonattainment areas with different classifications and possibly from sources in attainment areas. Thus, the origin of the emission reductions in such a pool would not represent a single attainment classification. As Section 173 prohibits the use of reductions from cleaner areas being used for offsets in dirtier areas, all allowances would contain some portion of such prohibited reductions. New Sources in non-attainment areas could still use the NO_x budget system to buy allowances from existing sources either within the same nonattainment area or from a source within another nonattainment area subject to the two step test Section 173 lays out. Thus even with the Act's restrictions, New Sources in nonattainment areas will be provided an easy mechanism for interstate purchases of emission offsets. With this understanding, the provisions for supplying emission offsets to New Sources in the NO_x budget system are as follows.

For new Affected Sources in attainment areas which need emission offsets, the allowances for 5 months of operation will satisfy a portion of this requirement, and these sources will also be guaranteed the opportunity to buy allowances from the set-aside account at an auction up to the total needed for offsets. Other New Sources not in the program but in the Budget Zone will also be able to buy allowances at auction. New Sources can also purchase allowances from existing sources at market prices.

For all New Sources in non-attainment areas which need emission offsets, allowances can be purchased at a market price from an existing source in the same non-attainment area, or subject to the restrictions of section 173 of the Clean Air Act from an existing source in a different non-attainment area.

After the New Sources have had the opportunity to purchase allowances at an auction, the remainder of the set-aside account will be allocated back to the existing sources, in proportion to the allowances they received.

5.9 Budget Zones

This parameter defines the geographic areas for one or more NO_x budgets that will be enforced through the program. The recommended options are:

1. One Budget Zone: the entire OTR.

2. One Budget Zone: the contiguous nonattainment areas along the coastal corridor, with or without some buffer zone of say 100 miles.

3. Two Budget Zones: (1) the contiguous non-attainment areas classified marginal and above along the coast, and (2) the remainder of the OTR.

4. Three Budget Zones: (1) the contiguous nonattainment areas classified marginal and above along the coast, (2) the remainder of the northern tier states (ME, NH, VT, northern NY), and (3) the remainder of the OTR.

Issue Paper #2 on ozone transport recommends that all portions of the OTR be included in the NO_x budget system. A single OTR budget would be the easiest to administer and would maximize trading opportunities. One Budget Zone along the coastal corridor would limit post-RACT NO_x control to the primary nonattainment areas, an approach likely to fail given the evidence regarding multi-day ozone episodes. Two Budget Zones with different limits would seem to provide the most flexible approach to the states as our knowledge about ozone control grows over the next few years. With too many Budget Zones, the OTR may tend to fracture into many sub-regions. Thus, the two Budget Zone option is preferred.

The proposed Budget Zones are shown in Figure 5 and using the emissions data base from Section 7, the distribution of emissions by Budget Zone and state are shown in Figures 6 and 7. As shown in Figure 5, Budget Zone 1 may be expanded to include major sources along the Susquehanna River in Pennsylvania and New York that are just west of the coastal nonattainment boundary and definitely affect air quality in those nonattainment areas. The buffer zone shown in Figure 5 adds counties to Budget Zone 1 so as to encompass power plants on both sides of the east and west branches of the Susquehanna River. In Pennsylvania these counties are: Bradford, Lycoming, Montour, Northumberland, Pike, Schuylkill, Synder, Sullivan, Susquehanna, Tioga, Union, and Wayne. In New York these counties are: Broome, Chenango, Columbia, Delaware, Otsego, Schoharie, Sullivan, Tioga, and Ulster.

FIGURE 5

PROPOSED NOx BUDGET ZONES IN THE OTR

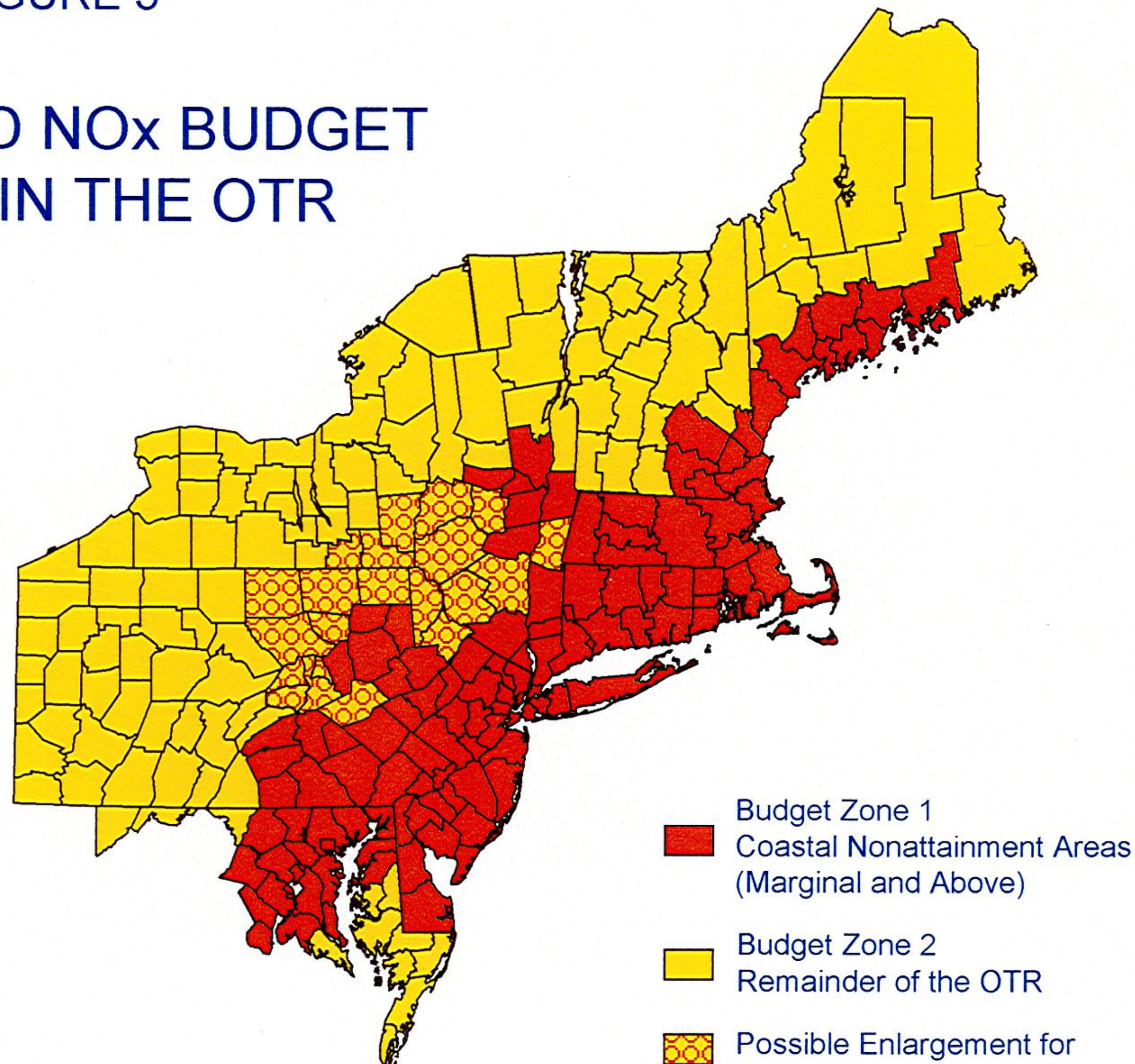
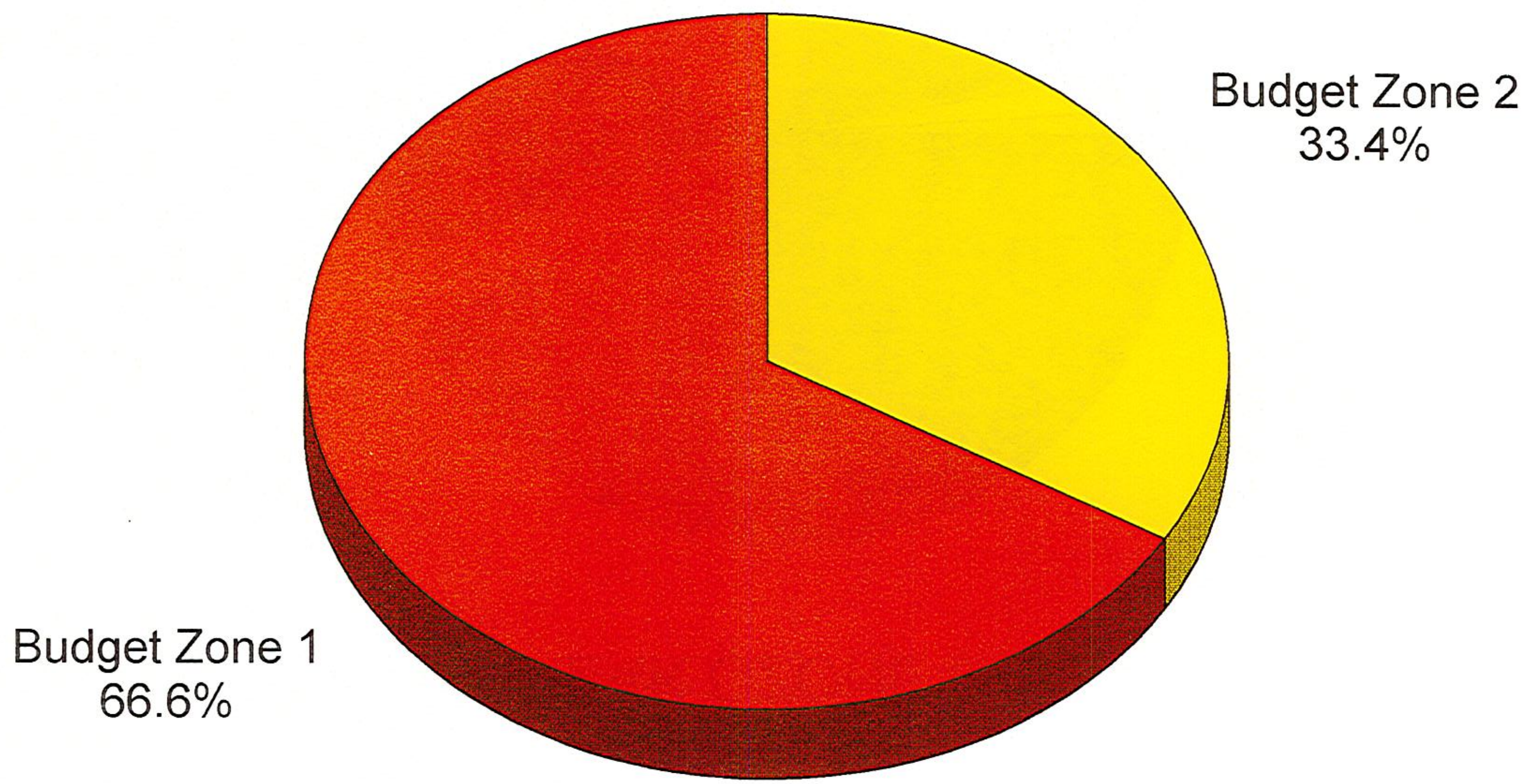


FIGURE 6

CLASSIFICATIONS OF 1990 STATIONARY SOURCE* NOx EMISSIONS IN THE OTR FOR THE PEAK OZONE DAY

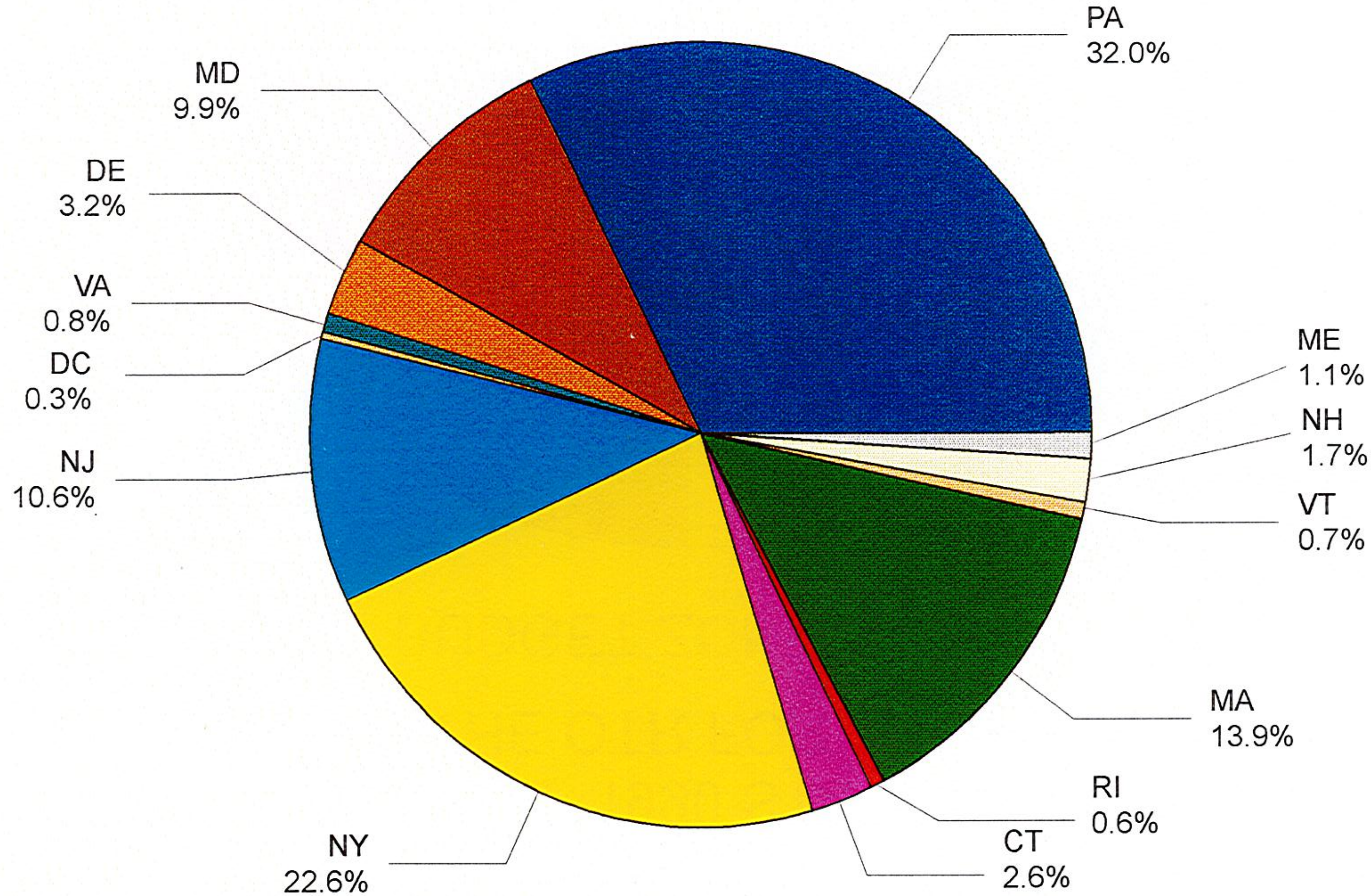
BY BUDGET ZONE (lbs/day)



* Includes sources with actual 1990 NOx emissions of 25 TPY or more

FIGURE 7

CLASSIFICATIONS OF 1990 STATIONARY SOURCE* NOx EMISSION IN THE OTR FOR THE PEAK OZONE DAY (lbs/day)



* Includes sources with actual 1990 NOx emissions of 25 TPY or more

While this study cautions against having more than two Budget Zones, it is acknowledged that a third zone of the northern tier attainment areas would allow those areas to craft a NO_x Budget Emission Rate that is to their advantage. The system could also be designed to allow such a northern tier zone access to the set aside accounts from Budget Zones 1 and 2 for purchasing allowances for emission offset requirements. Regardless, the number and boundaries of Budget Zones for the NO_x budget system will be consistent with those adopted by the OTC.

5.10 Trading Area

The parameter Trading Area defines the geographical extent of allowance trading. The three options are:

1. Trading allowed only within each Budget Zone.
2. Unrestricted trading allowed between Budget Zones.
3. Trading between Budget Zones is allowed. The NO_x Allowances traded will be adjusted in value by an exchange rate equal to the ratio of the Budget Emission Rates for the two Budget Zones.

As discussed in Issue Paper #2, all NO_x sources in the OTR appear to contribute to high measured ozone levels during episodes, although the relative effect of western versus eastern sources in the OTR may vary. In concept, a design that maximizes the trading area is best for making the market most cost efficient, in terms of dollar per ton of NO_x reduction. Thus Options 2 or 3 are preferred. The true objective is to make NO_x control most cost efficient in terms of dollar per ppm of ozone reduction. Since the relative effect on ozone episodes of NO_x reductions in western versus eastern portions of the OTR are not precisely known, unrestrained trading between Budget Zones may not be the best choice. Some restrictions on allowance trading between Budget Zones should be adopted, even though these are not mandated under the Clean Air Act (see Issue Paper #2). For these reasons, Option 3 is preferred.

As stated in the Project Assumptions section, it is expected that interstate trading of allowances will represent a small fraction (no more than 5%) of the overall NO_x budget. Under EIP rules, provision will need to be made in the program for the small effects of trading through an uncertainty factor, and data from the regional registry used to track trading and Banking will be used by the states to reconcile their projected and actual emission reductions. Given the inaccuracies of modeling, an uncertainty of no more than 5% due to trading is *de minimis* and will not require additional ozone modeling.

5.11 Banking

Banking provides for the retention of allowances that are not used in the year they are allocated for use in a future year. This parameter defines what restrictions will or will not be placed on such use of allowances in future years. The suggested options are:

1. No Banking of allowances. (No use of allowances beyond the year in which they are allocated).

2. NO_x Allowance Banking will be allowed. Banked allowances can be used in future years so long as their use will not jeopardize a State's SIP commitments for reasonable further progress (RFP) and attainment. To ensure that the SIP commitments are met, the program would include mechanisms states can employ to ensure that the number of banked emissions used in any ozone season would not exceed the number consistent with meeting these commitments.

3. NO_x Allowance Banking will be allowed; in addition, the total allowances allocated in a given year would be reduced by the amount of banked allowances. This would prevent the amount of allowances used exceeding the NO_x emissions budget for that year.

4. NO_x Allowance Banking with discounting. (Allowances would decrease in value with time.)

5. NO_x Allowance Banking with a time limit. (Allowances allocated in one year can be used at any time in the next five years after which time they expire).

Requiring all allowances to be used in the same year they are received is more restrictive, when combined with a declining budget, than a program which allows Banking. Furthermore, Banking provides an incentive for early reduction of emissions. As discussed in Issue Paper #1, other budget programs have faced the question of whether to allow Banking. One (RECLAIM) rejected Banking in its final design while others concluded that the flexibility offered by allowing Banking is important to providing incentives for early reductions and encouraging long-range planning by major sources. With proper safeguards, use of banked emissions that would unduly contribute to ozone exceedances can be prevented. Since the incentive for early reductions created by Banking is important to the NO_x budget system, Option 1 is not recommended.

While Banking can encourage early reductions, it is also imperative that the <u>use</u> of banked allowances be controlled to ensure the integrity of the declining NO_x Budget. Banking is really a burden-shifting exercise since early reductions can only be allowed to be spent at a later date if extra emission reductions are occurring at another source. Unrestricted use of banked allowances might encourage facility owners to game the system, e.g. create excess allowances with fuel switching in years when natural gas was cheap and use the banked allowances in other years when clean fuels are more expensive. And, some states have concerns over the use of banked allowances during ozone episodes. The NO_x Emissions Budget program would need to include mechanisms states can employ to ensure that the number of banked emissions used in any ozone season would not exceed the number consistent with meeting SIP commitments, as is indicated in Option 2. Such mechanisms could include allowing states to limit the number of banked allowances that can be used in any ozone season to a fixed level; the right to use banked allowances could be given on a first-come, first-serve basis or distributed through a lottery. Another possible mechanism could be limiting the allowed uses of banked allowances; for example, use of banked emissions could be prohibited except to allow for state-approved delayed compliance with a new emission standard.

Option 3 ensures that the NO_x budget will not be exceeded by reducing the number of allowances in each future year by the amount of banked allowances. While administratively simple, this automatic tightening of the regional NO_x budget could cause problems as the banked total grows with time, i.e., existing sources will see their increasingly valuable allowances garnished at a higher and higher rate. Option 3 is not recommended.

Under Option 4 the value of the banked allowances could, at a minimum, be discounted each year portionally to the amount, if any, that the NO_x budget is reduced that year. Or the amount of the discount could be greater, perhaps bringing the value of the banked allowances to zero within a few years. Options 4 and 5, while appearing to give states some control over the accumulation of allowances, may actually create incentives that are counter to the aims of the program. Discounting and time limit restrictions may encourage sources to spend their banked allowances sooner rather than holding on to them. For the sake of early reductions, the program should encourage as much Banking as possible for as long a period of time as possible. (It is the use of allowances not the Banking of them that states must Control.) Thus, Options 4 and 5 are rejected.

Option 2 is the preferred alternative because it provides incentives for early reductions, yet ensures that SIP limits will not be violated. However, should the mechanisms available to states to protect SIP limits prove too administratively unwieldy, or should it prove politically infeasible to establish an emissions budget that is sufficiently stringent as to provide a margin in which banked credits can be used without violating RFP limits, the recommended alternative is Option 1 which provides for no Banking of allowances from one averaging period to another and which would also ensure that the allowances used in any given averaging period do not authorize emissions in excess of the NO_x budget for that period.

5.12 Moth-Balled Units

This parameter defines how the program will treat emissions from units that were existing but did not operate in the base year. These might include standby or moth-balled units. The recommended options are:

1. Make allocations for all existing units regardless of operating history.
2. Make allocations for only those existing units that operated sometime in the period 1990-1994.

The options are related to standby and moth-balled units that while permitted are rarely operated. Granting allowances to all units ensures a company can re-activate a unit in the future and add it to those already operating, while limiting the allowances to units that have really been in use will in essence continue to treat unused equipment as standby equipment. Option 2 is preferred since Option 1 would allocate allowances along the lines of a potential to emit for units that are not reflected in baseline emissions and for which no basis exists for establishing an appropriate baseline activity level (except zero).

5.13 Shutdown Units

This parameter defines how the program will treat the future shutdown of an emission unit. The recommended options are:

1. NO_x Allowances will continue to be allocated in future years regardless of a unit's status. The right to receive allowance allocations each year can be transferred from one source to another. Trading of shutdown allowances may be restricted by the state to another source within the same state.
2. NO_x Allowances will cease to be allocated in the year following shutdown and the resulting allowances will not be re-allocated to any other source.

An option having the shutdown source's allowance allocation revert to the state to be used for "economic development" is <u>not</u> included here since comprehensive provision for New Sources has been made in Section 5.7 "New Sources" above. Furthermore, having the state dispense allowances to selected New Sources would undermine the auction mechanism described in Section 5.7 and would disrupt the market for trading allowances between sources. The handling of future shutdowns is a difficult subject since the choice communicates clear incentives to the Affected Sources. Option 2 which would cut off allocations to a Shutdown Unit will provide a disincentive for retiring older, dirtier units and shutdowns have historically provided substantial reductions in other programs, e.g., the Title IV acid rain program. For this reason Option 1 is preferred.

5.14 End of Trading Season

This parameter defines the "open window" for trading of allowances each year. The recommended options are:

1. Before the ozone season beings. Allowance trading each year must be concluded by April 30.
2. One month after the ozone season ends. Allowance trading each year must be concluded by October 31.

Regardless of which option is selected, the state will verify after the ozone season that a facility did not emit more NO_x than permitted by the allowances it held. Facility owners will be required to submit CEMS data to the states proving compliance. If violations occur, penalties consistent with the penalty provisions of the Clean Air Act will be imposed. There will need to be a central registry to track the allowances allocated to each combustion unit, the allowances traded between facilities, and the allowances "used up" by each facility. States will rely on this regional registry to support their enforcement activities.

One advantage of Option 1, requiring sources to have all allowances on hand before the ozone season, is that sources will naturally build in a safety margin and this will promote further NO_x reductions. A seasonal mass budget will be just as easily enforced under either Options 1 or 2 since compliance data would not be available until after the ozone season.

Option 2 will provide the regulated sources with much more flexibility in their NO_x reduction strategies. A sufficiently stiff penalty ($5,000 per ton is suggested since this is likely to be more than the cost of additional NO_x control that a source might undertake to ensure an adequate supply of allowances) coupled with a requirement that any source with actual emissions higher than allowances be required to retire an equivalent number of allowances from the following year's allocation, makes the risk from delaying enforcement minimal. The uncertainly over there being excess allowances to buy late in the season will probably still encourage conservative behavior on the part of electric generators, i.e., planning a safety margin. Thus, it seems reasonable to provide the added flexibility to the regulated sources and encourage trading of allowances. Option 2 is preferred.

5.15 ERC Interface

This parameter defines how sources outside of the NO_x budget system will be allowed to join and thereby sell surplus NO_x reductions in the form of new allowances to regulated sources. As discussed in the "Definitions" in Section 4.0, it is envisioned that other sources (point, area, mobile) could create an ERC and once the NO_x reduction was certified by a state, then a mechanism could be used for translating this ERC into an allowance in the NO_x budget system. By doing so, the total tonnage in the budget would increase but NO_x emissions in the Budget Zone would not increase since a certified reduction would be occurring in another source category. The states may want to consider whether any discount should apply for translating the ERC into a NO_x Allowance, i.e., should the net effect of the transaction be a reduction in NO_x emissions. The recommended choices are:

1. Create an ERC Allowance interface so non-regulated sources can opt-in.
2. Plans to phase in an ERC/Allowance interface will be considered in a future phase of program development.
3. No ERC/Allowance interface.

The reason for having an interface is to encourage cost-effective NO_x reductions for non-affected sources and increase the number of allowances in the trading system. Note that this provision does not apply to sources physically outside the Budget Zone because the EIP rules require that opt-in provisions ensure no increase in emissions within the area covered by an EIP.

Adding an opt-in feature to the program will complicate it administratively. First, a mechanism for translating ERC's into allowances would have to be devised. Second, states will have to correct their inventories for the increase in the budget. And third, because "surplus" reduction is a dynamic concept, an ERC's value may be diminished in the future by changes to a state's SIP and the program would have to have a mechanism for dealing with the resulting change in allowance value. Since this provision is not essential to the bulk of the NO_x reductions which are needed by 1999, the states should first get the program going and then try to phase-in this element. Option 2 is preferred.

6.0 PROPOSED DESIGN OF THE NO_x EMISSIONS BUDGET SYSTEM

6.1 Summary Description

Assembling the preferred options for each program parameter discussed in the previous section defines the initial NO_x budget design, summarized below.

Parameter	Preferred Option
Affected Sources	All electric generating facility fuel combustion units (utility or NUG) with a rated output of 15 MW or more, and all industrial boilers with a heat input of 250 MMBtu/hr or more.
Control Period	The ozone season: the five month period from May 1 to September 30.
Daily Limit	No 24-hour emission limit; the allowances allocated to each facility will set a seasonal limit. Projected daily emissions will be used to demonstrate RFP and attainment in the SIP. An annual audit will determine if actual daily emissions exceed the projected daily emissions. If such exceedance occurs, reconciliation procedures will be implemented prior to the next ozone season to ensure projected emission reduction levels are met.
NO_x Allowances	The NO_x Allowances allocated to each Affected Source each year will be equal to (0.005 ton/lb) x (Baseline Activity Measure) x (Budget Emission Rate).
Baseline Activity Measure	For Affected Sources in existence in 1994, the actual heat input to a fuel combustion unit during the ozone season in 1994, or if 1994 is not representative, then the average for the ozone seasons in the period 1990-1993 that the source operated. Units are in MMBtu/5 months. For new Affected Sources that begin normal operation after May 1, 1994, the design heat input rate for the 5 month ozone season,

adjusted by any operational restrictions in the New Source permit.

Budget Emission Rate	For Affected Sources in existence in 1994, either: (1) fuel specific rates, or (2) a single, fuel independent number. The value of Budget Emission Rate may differ between the Budget Zones. Units are in lb/MMBtu. For new Affected Sources that begin normal operation after May 1, 1994, the lesser of the permit NO_x limit or the Emission Rate for existing sources. The states will first determine the total NO_x budget in a Budget Zone, then knowing the total Baseline Activity Measures, they will set the Budget Emission Rate accordingly. The Budget Emission Rate is only used to define NO_x Allowances to be allocated to a facility and is <u>not</u> imposed as a limit on individual sources.
Target Program Start-Date	1997
Target End-Date	2003 (target for reducing budget to level needed for attainment throughout the OTR).
Number of Steps	Periodic steps downward every two or three years, reducing the total number of allowances allocated.
New Sources	Purchase allowances at an auction from a small set-aside account (e.g., 2%). The set-aside account will be increased with time as needed. New Affected Sources will be guaranteed the opportunity to buy enough allowances for full operation (see the definition of Baseline Activity Measure).
Emission Offsets	For new and modified Affected Sources in *attainment areas* which need emission offsets, the allowances for 5 months of operation will satisfy a portion of this requirement, and these sources will also be guaranteed the opportunity to buy allowances from the set-aside account at an auction up to the total needed for emission offsets. Other New Sources

not in the program but in the Budget Zone will also be able to buy allowances at auction.

For all new and modified sources in *non-attainment areas* which need emission offsets, allowances can be purchased at a market price from an existing source in the same non-attainment area, or subject to the restrictions of section 173 of the Clean Air Act from an existing source in a different non-attainment area.

After the New Sources have had the opportunity to purchase allowances at auction, the remainder of the set-aside account will be allocated back to the existing sources, in proportion to the allowances they received.

Budget Zones

Two Budget Zones are recommended: (1) the contiguous non-attainment areas classified marginal and above along the coast, and (2) the remainder of the OTR. Budget Zone 1 may be expanded to include sources along the Susquehanna River.

The final number and boundaries of Budget Zones will be consistent with those adopted by the OTC.

Trading Area

Trading between Budget Zones is allowed. The NO_x Allowances traded will be adjusted in value by an exchange rate equal to the ratio of the Budget Emission Rates for the two Budget Zones.

Banking

NO_x Allowance Banking will be allowed. It is imperative that the use of banked allowances be controlled to ensure the integrity of the declining budget. Banked allowances can be used in future years so long as their use will not jeopardize a State's SIP commitments. The program would include mechanisms states can employ to ensure that the number of banked emissions used in any ozone season would not exceed the number consistent with meeting these commitments.

Moth-Balled Units

Allowances will be only be allocated to those existing units that operated sometime in the period 1990-1994.

Shutdown Units	NO_x Allowances will continue to be allocated in future years regardless of a unit's status. The right to receive allowance allocations each year can be transferred from one source to another. Trading of shutdown allowances may be restricted by the state to another source within the same state.
End of Trading Season	One month after the ozone season ends. Allowance trading each year must be concluded by October 31. Facility owners will be required to submit reports based on CEMS data to the states proving the 5 month emissions of Affected Sources did not exceed NO_x Allowances in hand on October 31.
ERC Interface	Plans to phase in an ERC/Allowance interface will be developed in a future phase of program development.

6.2 Technical Issues Needing Further Work

There are three issues that will warrant further study while developing the full technical detail needed to implement a NO_x budget system. These are outlined in the sections below.

6.2.1 Accounting for Load Shifting

The imposition of post-RACT NO_x limits on electric generating units in western Pennsylvania could encourage less generation of power in Pennsylvania and more importation of power from Ohio and other states outside the OTR. A concern is whether increased power production just west of the OTR will contribute to ozone nonattainment problems inside the OTR. A certain amount of power exchange between regions occurs normally and changes over time due to numerous factors. An ideal NO_x budget system might be able to account for such load shifting to generating units with higher NO_x emission rates. Before an accounting mechanism can be developed, further work is needed to answer some basic questions such as:

- Under the NO_x budget system envisioned in this report, how much load and NO_x emissions will likely be shifted to areas west of the OTR?
- Will the net redistribution in NO_x emissions (decrease in the OTR and increase west of the OTR) under load shifting contribute to ozone nonattainment problems inside OTR?
- If load shifting will degrade air quality inside the OTR, what mechanisms should be designed to account for this effect in the NO_x budget system? These might include a proportional adjustment in allowance allocations if power imported for different purposes can be distinguished, or a pricing or dispatch adjustment for imported power.

6.2.2 Feasibility of Projecting 24-Hour NO_x Reductions

As discussed in Section 5.3, the recommended system design relies on a seasonal mass emissions budget but no 24-hour budget or limit for individual sources. Daily emission reductions for an ozone season day resulting from a seasonal NO_x budget will need to be statistically projected by the states using 24-hour NO_x emissions information provided by the Affected Sources. Whether a valid demonstration, satisfactory to EPA, of the daily emission reductions that would be realized through a seasonal NO_x budget is feasible or not remains to be seen. However, such a demonstration would be a prerequisite for proceeding with a seasonal budget, rather than a daily limit. Such a demonstration would need to be based on information from the Affected Sources, including records showing their daily NO_x emissions in the 1990-1994 period and projections of their future anticipated daily emissions levels based on their current control plans and their anticipated activity levels. This demonstration would be the basis for the states to be able to claim credit for the full anticipated benefits of the NO_x budget system in their SIP's.

6.2.3 Spatial Effects of Allowance Trading

The allowance trading system will result in some sources over-controlling and others under-controlling relative to the NO_x Allowances that are allocated each year. An economic analysis of where these differences will occur is warranted to ensure that trading will not spatially shift NO_x emissions in a way that will hinder ozone control efforts.

6.2.4 Interface With Operating Permits

The source's Operating Permit is proposed as the federally enforceable mechanism for the NO_x budget system. The interface with Operating Permit requirements needs to be researched further. For example, the mechanism for allocating allowances should be designed such that a facility's Operating Permit does not need to be reopened each year to reflect any change in the number of allowances allocated to the facility.

6.2.5 Emission Offset Requirements

Although the use of NO_x Allowances to satisfy emission offset requirements is discussed extensively in Section 5.8, more work needs to be done on the interface between the NO_x budget system and emission offset rules. There may be a better approach to providing for the emission offset requirements of new or modified sources that will be encompassed by the NO_x budget system. Consistency with all EPA policies and rules needs to be reviewed.

6.3 Technologically Feasible NO_x Limits

The purpose of this section is to summarize current information on technologically feasible NO_x limits (in lb/MMBtu) for utility boilers and gas turbines with a rated output of 15 MW or more, and for industrial, commercial, and institutional (ICI) boilers with a heat input of 250 MMBtu/hr or more. In doing so, this chapter borrows from existing sources of information[8,9] and only gives an overview of a highly complex subject. Descriptions of control technologies are brief and the reader is referred to the referenced documents for more detail and the latest information on costs in dollars per ton of NO_x removed. The feasibility of retrofit NO_x controls on an existing fuel combustion unit has to be evaluated on a case-by-case basis due to the wide variation in equipment design, age and condition, operating parameters and fuel. The choices for a particular unit are often limited.

The majority of NO_x emissions are formed in two ways in a fuel combustion unit. The key parameters in this formation are combustion temperature, fuel/air mixture, residence time within the combustion chamber and fuel nitrogen content. First, "thermal NO_x" is created by the oxidation of nitrogen molecules in the high temperature combustion air. Second, "fuel NO_x" is produced from chemical reaction of fuel-bound nitrogen with oxygen. Thermal NO_x production is retarded by reducing peak temperatures within the combustion zone. Fuel NO_x emissions from high nitrogen fuels (e.g., coal) are controlled by introducing the fuel with less air than is needed for complete combustion; fuel nitrogen is then released into a reducing, rather than oxidizing, environment which encourages reduction to N_2 rather than oxidation to NO_x. Combustion is then completed by introducing more air at a second stage. This strategy is referred to as staged combustion.

6.3.1 Utility and ICI Boilers

Utility boilers and ICI boilers of at least 250 MMBtu/hr heat input are generally constructed in the same manner and are discussed together in this study. NO_x control strategies for these boilers fall into three categories.

- Seasonal fuel switching to cleaner fuels, e.g., coal to oil or gas, oil to gas;
- Combustion controls;
- Flue gas treatment.

Combustion controls reduce NO_x formation during the combustion process and include methods such as operational modifications, flue gas recirculation (FGR), overfire air (OFA), low NO_x burners (LNB), and Reburn. Flue gas treatment controls reduce NO_x emissions after its formation and include selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR).

Operational modifications involve changing certain boiler operational parameters to create conditions in the furnace that will lower NO_x emissions. For example, burners-out-of-service (BOOS) consists of removing individual burners from service by stopping the fuel flow. The air flow is maintained through the ideal burners to create a staged-combustion atmosphere within the furnace. Low excess air (LEA) involves operating the boiler at the lowest level of excess air possible without jeopardizing good combustion. And, biased firing (BF) involves injecting more fuel to some burners and reducing the amount of fuel to other burners to create a staged-combustion environment.

Flue gas recirculation (FGR) is a flame-quenching strategy in which the recirculated flue gas acts as a diluent to reduce combustion temperatures and oxygen concentrations in the combustion zone. This method is effective for reducing thermal NO_x and is used on natural gas- and oil-fired boilers. Flue gas recirculation can also be combined with operational modifications or other types of combustion controls on natural gas- and oil-fired boilers to further reduce NO_x emissions. Flue gas recirculation is not used on coal-fired boilers for NO_x control. Overfire air (OFA) is another technique for staging the combustion process to reduce the formation of NO_x. Overfire air ports are installed above the top row of burners on wall and tangential boilers.

Low NO_x burners (LNB) are designed to delay and control the mixing of fuel and air in the main combustion zone. Lower combustion temperatures and reducing zones are created by the LNB which lower thermal and fuel NO_x. Low NO_x burners and OFA can be combined in some retrofit applications provided there is sufficient height above the top row of burners. Low NO_x burners can also be combined with operational modifications and flue gas treatment controls to further reduce NO_x emissions.

Reburn is a NO_x control technology that involves diverting a portion of the fuel from the burners to a second combustion area (reburn zone) above the main combustion zone. Completion air (or OFA) is then added above the reburn zone to complete fuel burnout. The reburn fuel can be either natural gas, oil, or pulverized coal; however, most of the experience is with natural gas reburning. There are many technical issues in applying reburn, such as maintaining acceptable boiler performance when a large amount of heat input is moved from the main combustion zone to a different area of the furnace. Reburn can be applied to most boiler types and is the only known combustion NO_x control technique for cyclone boilers although flue gas treatment controls may also be effective on these boilers.

Two commercially available flue gas treatment technologies for reducing NO_x emissions from existing fossil fuel utility boilers are SNCR and SCR. Selective noncatalytic reduction involves injecting ammonia (NH_3) or urea into the flue gas in specific high-temperature zones in the upper furnace or convective pass. For this method to be effective, the injection must occur within a certain temperature range. Ammonia emissions must be minimized because NH_3 is a pollutant and can also react with sulfur oxides in the flue gas to form ammonium salts, which can deposit on downstream equipment such as air heaters.

The other flue gas treatment method, SCR, involves injecting NH_3 into the flue gas in the presence of a catalyst. Selective catalytic reduction promotes the reactions by which NO_x is converted to nitrogen and water at lower temperatures than required for SNCR. The SCR reactor can be placed before the air preheater (hot-side SCR) or after the air preheater (cold-side SCR). The catalyst may be made of precious metals (platinum or palladium), base metal oxides (vanadium/titanium are most common), or zeolites (crystalline aluminosilicate compounds). While SCR has been applied to some natural gas- and oil-fired boilers in the United States (primarily California), its use in the United States on coal has been limited to slip-stream applications. Several full-scale utility coal-fired SCR systems are currently under construction on new boilers. Flue gas treatment controls can be combined with combustion controls to achieve additional NO_x reduction.

The expected NO_x emissions from utility and large ICI boilers retrofit with combustion controls, flue gas treatment, or both are summarized in Tables 3 and 4 from EPA's Alternative Control Techniques Document.[8] NO_x emission rates of 0.10 lb/MMBtu or lower, where feasible, generally require flue gas treatment controls.

TABLE 3

EXPECTED NO_x EMISSIONS FROM EXISTING COAL-FIRED UTILITY AND LARGE ICI BOILERS* RETROFIT WITH NO_x CONTROLS

Control Technology	NO_x Reduction Potential (%)	Range of Expected NO_x emissions (lb/MMBtu)
Combustion Controls		
BOOS, LEA, BF	10-20	0.55-0.80
OFA	20-30	0.50-0.70
LNB	35-60	0.25-0.55
Reburn	50-60	0.30-0.75
Flue Gas Treatment		
SNCR	30-60	0.20-1.10
SCR	75-85	0.10-0.40
LNB + SNCR	50-80	0.15-0.45
LNG + SCR	85-95	0.05-0.15

*Fluidized bed combustion boilers are not included in the table, but can achieve 0.1-0.3 lb/MMBtu with combustion controls and 0.03-0.1 lb/MMBtu with SNCR.

Source: EPA ACT Document.[8]

TABLE 4

EXPECTED NO_x EMISSIONS FROM EXISTING OIL- AND GAS-FIRED UTILITY AND LARGE ICI BOILERS RETROFIT WITH NO_x CONTROLS

Control Technology	NO_x Reduction Potential (%)	Range of Expected NO_x Emissions (lb/MMBtu)
Combustion Controls		
LEA + BOOS	30-50	0.10-0.35
OFA	20-45	0.10-0.45
LNB	30-50	0.10-0.35
FGR	45-55	0.10-0.30
LNB + OFA	40-50	0.10-0.30
FGR + Another Control	60-90	0.05-0.25
Reburn	50-60	0.10-0.25
Flue Gas Treatment		
SNCR	25-40	0.10-0.40
SCR	80-90	0.03-0.25
LNB + SNCR	70-80	0.05-0.25
LNB + SCR	85-95	0.02-0.25

Source: EPA ACT Document[8]

6.3.2 Gas Turbines

A gas turbine is an internal combustion engine that operates with rotary motion. Hot combustion gases are directed through one or more fan-like turbine wheels to generate shaft horsepower. There are two types of turbines: industrial and aero-derivative and designs cover four types of cycles: simple, regenerative, cogeneration, and combined. As with boilers, the design and emission rates of individual units vary widely. The principal fuels used in gas turbines are natural gas and distillate oil. NO_x control strategies fall into categories:

- Water/steam injection
- Dry combustion modifications
- Flue gas treatment.

Water/steam injection is the most prevalent NO_x control strategy. The water or steam is injected with air and fuel into the turbine combustor to lower peak temperatures which in turn decreases thermal NO_x production. Injection ratios are usually described by a water-to-fuel ratio on a weight basis. The NO_x reduction obtainable with water/steam injection is in the range of 60-94% with typical controlled NO_x emission rates of 0.14 lb/MMBtu for natural gas-fired turbines and 0.29 lb/MMBtu for oil-fired turbines.[9] Dry combustion modifications include lean combustion, reduced combustor residence time, lean pre-mixed combustion, and two-stage combustion. NO_x reductions achievable with dry combustion modifications are in the range of 30-90% with controlled NO_x emission rates in the range of 0.03-0.30 lb/MMBtu for natural gas-fired turbines and 0.22-0.49 lb/MMBtu for oil-fired turbines, depending on the technique selected.[9,10]

SCR is the only flue gas treatment used with gas turbines since the operating temperature window for SNCR is not compatible with gas turbine exhaust temperatures, and the residence time required for SNCR can not be achieved. Although SCR is capable of 80-90% NO_x removal, or higher, it requires water or steam injection to remove most of the NO_x before SCR polishes the gas stream to very low levels. Controlled NO_x emission rates are typically 0.03 lb/MMBtu for natural gas-fired turbines and 0.06 lb.MMBtu for oil-fired turbines.[9,10]

6.4 Enforcement

Each Affected Source will be subject to a seasonal mass-emission limit for NO_x that equals the sum of:

- NO_x Allowances allocated to the Source at the beginning of the year;
- Plus banked NO_x Allowances the Source has withdrawn for use in the current year (pre-approval from the state may be necessary);
- Plus NO_x Allowances purchased from another Affected Source or the set aside account;
- Minus NO_x Allowances sold to another Affected Source.

As discussed in the next section, a regional central registry will be used to track the accounting of NO_x Allowances for each Affected Source. The state will be responsible for enforcing the mass emissions limit using data from the registry. Enforcement will be based on CEMS data submitted by each source to the state by October 31 of each year for the ozone season of May 1 through September 30. Sources will have a 30-day period after September 30 to purchase any additional NO_x Allowances on the open market to cover actual emissions. If an Affected Source's actual ozone season NO_x emissions exceed the mass emissions limit in any given year, the state will take the following enforcement actions:

(1) A penalty of $5,000 per ton will be assessed for every ton of NO_x emitted over the mass emission limit.

(2) The NO_x Allowances allocated to the source in the following year will be reduced by the excess emissions. (A one-year reduction.)

It is recommended that the excess emission penalty be a fixed amount and not tied to some market value to prevent allowance holders from "gaming" the system. The penalty amount should be at least twice the cost of additional NO_x control that a source would have to install to remain in compliance, in order to discourage sources from violating their mass emission limit. As post-RACT NO_x control can be over $2,000 per ton, a figure of $5,000 per ton for the excess emission penalty is recommended. The penalty selected needs to be consistent with the penalty provisions of the Clean Air Act.

All Affected Sources in the NO_x budget system will be required to have a CEMS for NO_x. Almost all of the Affected Sources in the NO_x budget system are already subject to the Title IV acid rain regulations that require a CEMS for monitoring SO_2 and NO_x to be installed and certified by January 1, 1995 as part of Phase II of the acid rain control program. Some large industrial boilers that qualify as Affected Sources in the NO_x budget system and do not already plan to install CEMS to satisfy the enhanced monitoring requirements for their Title V Operating Permit may need to purchase a CEMS for NO_x. As every Affected Source will already hold a Title V Operating Permit by the time the NO_x budget system is implemented, it is recommended that the system use the monitoring, recordkeeping and reporting requirements in a source's Operating Permit to enforce the mass emissions limit.

Title V operating permits are issued for a term of five years. If, as envisioned in this conceptual design, the number of allowances given a source changes from year to year, it may be necessary for allowances to be allocated in advance for five-year periods, to avoid reopening the operating permit every year to make changes. This is an issue that needs to be studied further in implementing the NO_x budget system.

6.5 Administration

Administration of a NO_x budget system will require the involvement of both the states and some regional organization. A central registry will be needed to track the allocation, use, trading, and Banking of NO_x Allowances in each state, Budget Zone and for the OTR as a whole. Since interstate allowance trading is a part of this system, the registry has to be maintained by a regional organization. The central registry would ideally be setup as an on-line data base that Affected Source, states, and EPA could access at any time to check the status of the system. In addition to tracking allowances, the regional entity will be responsible for actually allocating allowances to existing sources and running the sale and auction of allowances from the set aside account to New Sources each year. The possible regional entities for this responsibility include: MARAMA and/or NESCAUM; the EPA Regional Offices; the EPA Acid Rain Office (which is already handling regional NO_x data for Title IV); the OTC; or a new regional governmental entity (e.g., a NO_x Budget Control Commission). Any one of these might choose to handle the administrative responsibilities with their staff or simply oversee a private contractor who would do the work. Since there are issues that extend across the entire OTR, it is recommended that either the OTC or the EPA Acid Rain Office be selected for this part of the administrative role. The EPA Acid Rain Office already has in place an Emissions Tracking System (ETS) and Allowance Tracking System (ATS) for tracking SO_2 and NO_x CEMS data under Title IV. The states should explore the possibility of adapting those systems to this program.

State responsibilities for a part of the NO_x budget system are essential since the system will be implemented as an EIP through a revision to each state's SIP. As discussed in detail in Sections 5.3 and 6.3, there are data collection, compliance assurance, enforcement, audit and reconciliation tasks that the states must perform. In addition, the states in the NO_x budget system will need to meet periodically to review, and if necessary, revise the agreed upon Budget Emission Rates for the Budget Zones (which will be declining with time) and other regional implementation issues regarding the system.

Funding will obviously need to be secured by both the states and the regional entity to cover the costs of administration. The imposition of fees on the Affected Sources is one possibility. The Affected Sources will be the primary beneficiaries of the NO_x Emission Budget system, in that it is anticipated that the cost of achieving the necessary level of NO_x emission reductions will be reduced significantly through the implementation of this system (see Section 9). Another possibility is the use of EPA Section 105 grant money. This grant money would be allocated to the participating states to help cover their administrative costs, proportional to each state's share of the regional NO_x Allowances in the system. Section 105 grant money is appropriate to assist the states in covering administrative costs since the NO_x budget system is a part of regional ozone attainment planning.

Guidance submitted by EPA Headquarters states that source specific activities in the NO_x budget system must be funded with Title V operating permit fees. These items include compliance assurance, enforcement and perhaps data collection. Section 105 grant money cannot be used to support activities of Title V sources, and all Affected Sources will be Title V sources. Activities that are eligible for Section 105 grant money include: developing the registry, allocating allowances, running the auction of allowances and handling implementation issues.

7.0 EMISSIONS DATA BASE

The objective of the emissions data base task was to assemble a consistent, comprehensive inventory for all NO_x point sources in the Ozone Transport Region (OTR) with actual emissions of 25 tons/yr or more. The threshold refers to the emissions of an individual unit, not a facility. The data represent the 1990 base year for the Clean Air Act and adjustments were then applied for RACT Phase I controls (1995) and NO_x budget (2003).

7.1 Creating the Database

The initial plan was to assemble data from the twelve states and D.C. A data request was sent out to each state by NESCAUM in mid-April, 1994 (see Appendix B). The response by the states was disappointing. Only half responded and those that did provided data that was often incomplete or inaccessible to a spreadsheet. The only complete emissions inventory for 1990 covering the OTR that could be obtained was EPA's 1990 Interim Emission Inventory[11] in the form of ROM modeling input files. Details on the sources surveyed and the reasons why the EPA Interim Inventory was used are given in the May 17, 1994 Status Report contained in Appendix B.

The EPA 1990 Interim Emissions Inventory[11] uses Forms EIA-767 (Steam Electric Plant Operation and Design Report) and EIA-759 (Monthly Power Plant Report) filed with the U.S. Department of Energy for 1990 by electric utilities as the principal source of information for fossil-fuel steam electric generating units. Non-utility point source data were projected by EPA from the 1985 National Acid Precipitation Assessment Program (NAPAP) Inventory. While more accurate data can be assembled for individual point sources, the EPA inventory was judged adequate for the purposes of this project.

The inventory was organized into individual state files and these were split into non-attainment designation groups. Within each of the resulting files, the sources were further segregated into four categories: electric generating units (SIC 4911) with a rated capacity of 15 MW or more; industrial boilers with a heat input of 250 MMBtu/hr or more; all other industrial/institutional boilers; and other NO_x sources. Missing data were calculated whenever possible from other fields in the data records. As a quality control check, the given or calculated 1990 NO_x emission rates (in lb/MMBtu) were reviewed for values that appeared unreasonable. Many errors were found in the EPA inventory, the two most common being the wrong value for the heat content of fuel and decimal point placement errors in annual emissions (overestimated by factors of 10 to 1000). Data from other fields, primarily the SCC code, were used to deduce which data fields contained the error, and the corrected value inserted into the data record was chosen for consistency with all other fields.

The data files were then organized to provide totals of: (1) annual NO_x emissions for 1990; and (2) peak ozone day NO_x emissions. The latter term presumed average summer day emissions for all sources but electric generating units whose emissions are highly correlated with the high temperatures that occur during ozone episodes. For electric generating units, maximum summer day emissions were assumed, i.e., maximum heat input times the emission rate. Utility representatives at both the New England and New York Power Pools stated that on peak days practically all generating units that are available will be running and at a load close to capacity. NEPOOL's latest Forecast Report of Capacity, Energy, Loads and Transmission[12] provides confirmation for these assumptions. In that report the projected August peak load forecast (defined as the load exceeded 10% of the time in August) for 1999 is 24,965 MW compared to total system capacity of 25,355 MW. In the year 2005, the peak load forecast of 27,874 MW actually exceeds the projected system capacity of 25,155 MW. The peak loads are unadjusted totals and will be slightly lower due to DSM and other factors. Nonetheless, the data confirm that for the foreseeable future it is reasonable to use the maximum daily emission rate as a rough estimate of electric generating unit emissions on peak ozone days.

For the states that did submit detailed 1990 inventory data, an attempt was made to match up the data with records in the EPA inventory. This proved to be infeasible because the EPA modeling files lack a facility or source name. Trying to match combustion units by other parameters (fuel, SCC code, heat input rate) also proved to be infeasible due to variations in the data and the large number of data records involved. Officials from one state (Connecticut) also tried to cross-reference the two data bases on their own and reached the same conclusion. Only in one state (Vermont) was it possible to perform a cross-reference check, source by source, and there it was discovered that five sources were missing and these were added to the EPA inventory.

Quality control checks on the number of sources and ozone totals by state were performed for the electric generating sector (SIC 4911) in four states: New Jersey, Connecticut, Delaware and Virginia. For New Jersey, the results shown in Table 5 were obtained. The NJ DEP listed no sources in the Severe-15 portion of the state and their total for the Severe-17 area matches the combined total in the EPA inventory for both areas. Clarification has been requested from DEP on this discrepancy. For the Moderate portion of the state, the totals match closely. For the other three states, the comparison of electric generating source emissions is shown in Table 6. These comparisons indicate that the EPA 1990 Interim Inventory is reasonably close to the more recent inventory data the states have on file.

TABLE 5

COMPARISON OF THE EPA 1990 INTERIM INVENTORY WITH RECENT NJ DEPE 1990 INVENTORY DATA FOR NO_x EMISSIONS FROM ELECTRIC GENERATING UNITS IN NEW JERSEY

Non-Attainment Designation	EPA 1990 Inventory		NJ DEP Response to the Data Request	
	No. of Sources	Annual NO_x (tpy)	No. of Sources	Annual NO_x (tpy)
Severe-17	40	25,924	45	43,650
Severe-15	15	21,244	0	0
Moderate	10	11,583	3	11,758

TABLE 6

COMPARISON OF THE EPA 1990 INTERIM INVENTORY WITH RECENT 1990 INVENTORY DATA FROM THREE STATES FOR NO_x EMISSIONS FROM ELECTRIC GENERATING UNITS

State	EPA 1990 Inventory		State Response to the Data Request	
	No. of Sources	Annual NO_x (tpy)	No. of Sources	Annual NO_x (tpy)
Connecticut	26	23,735	25	24,266
Delaware	54	34,570	56	45,818
Virginia	27	*	26	*

* Virginia did not provide annual emissions for electric generating units.

7.2 Analysis of the Data Base

Emission estimates for 1995 were derived from the 1990 data in the EPA inventory by applying a uniform 30% control efficiency to all sources for NO_x RACT reductions. (30% is a rough estimate of the overall effect of NESCAUM recommendations on NO_x RACT.[13] The actual reduction varies from source to source). It was not possible to adjust for RACT on a source-by-source basis since: (1) most states did not supply this information; and (2) as discussed earlier it was not feasible to cross-reference the individual sources in the EPA inventory and the state responses. Where NO_x controls were in effect prior to RACT, these were taken into account.

Emission estimates for 2003 were obtained by applying a NO_x limit to ozone season emissions for sources in the two groups proposed to be regulated by NO_x budgets: (1) electric generating units with a rated capacity of 15 MW or more; and (2) industrial boilers sized 250 MMBtu/hr and larger. Four different budget scenarios were analyzed to determine the resulting NO_x reductions, see Table 7. While the Budget Emissions Rates in Table 7 are not specific recommended values, they do fall in the range of 0.1 to 0.2 lb/MMBtu adopted as Phase II goals by the NESCAUM States.[13] Sources will actually be regulated by seasonal mass emission budgets (not rate limits) under the NO_x budget program, and it is recognized that the daily and annual emission estimates for 2003 are only approximations of the true effect of the NO_x budget system.

TABLE 7

FOUR NO_x BUDGET SCENARIOS FOR 2003

Scenario	Budget Emission Rates (lb/MMBtu)	
	Budget Zone 1	Budget Zone 2
A	0.20	0.25
B	0.15	0.20
C	0.15	0.15
D	0.20/0.10*	0.20/0.10*

* Coal Limit/Oil and Gas Limit

The data base probably over-estimates the daily NO_x emissions during the ozone season with a NO_x budget program in place, for the following reasons:

- In the emission data base, the higher value of design heat input is used to approximate a combustion unit's maximum daily heat input, since data on the latter is not presently available.

- Source owners will normally plan for lower emissions than the number of allowances they will hold due to their uncertainty over the number of hours a unit will need to run and the uncertainty over the emission rate.

The data base also probably overestimates the annual NO_x emissions (underestimates the annual reductions) with a NO_x budget program in place, for the following reasons:

- In the emissions data base for the non-ozone season months, it is assumed that a combustion unit will operate at its RACT emission rate. If the owner installs control equipment or makes other permanent changes to the combustion unit (other than fuel switching) to comply with the NO_x budget, then the non-ozone season emission rate will be lower than RACT.

- Ozone season emissions are over-estimated as explained above.

Tables 8-13 and 14-19, respectively, present the annual and peak ozone season NO_x emissions from the sources which would be subject to the NO_x budget program. The emissions data are summarized in Figures 8 and 9, and presented in more detail in Tables 8-19. Figure 8 shows clearly that while the proposed NO_x budget will only apply during the ozone season, that substantial reductions in annual NO_x emissions will occur. Annual reductions from 1995 to 2003 are in the range of 18% to 23%. Figure 9 and Table 20 show that peak ozone day NO_x emissions will drop 59% to 71% relative to the 1990 baseline under a NO_x budget program.

TABLE 8

1990 ANNUAL
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
(tons/year)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	100,272	346,660	446,932
Maryland	110,553	8,098	118,651
Delaware	34,569	0	34,569
Virginia (portion)	5,162	0	5,162
District of Columbia	1,925	0	1,925
New Jersey	91,266	0	91,266
New York	115,583	119,314	234,897
Connecticut	28,276	0	28,276
Rhode Island	2,633	0	2,633
Massachusetts	87,119	0	87,119
Vermont	0	645	645
New Hampshire	24,096	911	25,007
Maine	10,821	4,981	15,802
Total for the OTR	612,275	480,609	1,092,884
Electric Generating Units 15+ MW	482,483	394,119	876,602
Industrial Boilers 250+ MMBtu/hr	31,075	29,188	60,263
Other Industrial/ Institutional Boilers	50,216	39,490	89,706
Other Point Sources	48,501	17,812	66,313
Total for the OTR	612,275	480,609	1,092,884

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 9

1995 ANNUAL
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
(tons/year)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	70,199	245,843	316,042
Maryland	78,754	5,668	84,422
Delaware	24,870	0	24,870
Virginia (portion)	3,613	0	3,613
District of Columbia	1,347	0	1,347
New Jersey	66,558	0	66,558
New York	84,042	87,261	171,303
Connecticut	21,553	0	21,553
Rhode Island	1,843	0	1,843
Massachusetts	63,530	0	63,530
Vermont	0	451	451
New Hampshire	16,866	682	17,548
Maine	8,221	3,487	11,708
Total for the OTR	441,396	343,392	784,788
Electric Generating Units 15+ MW	347,865	282,430	630,295
Industrial Boilers 250+ MMBtu/hr	21,754	20,431	42,185
Other Industrial/ Institutional Boilers	35,288	27,669	62,957
Other Point Sources	36,489	12,862	49,351
Total for the OTR	441,396	343,392	784,788

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 10

2003 ANNUAL
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO A
(tons/year)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	57,998	196,744	254,742
Maryland	61,737	4,764	66,501
Delaware	19,682	0	19,682
Virginia (portion)	2,960	0	2,960
District of Columbia	1,298	0	1,298
New Jersey	54,721	0	54,721
New York	77,337	71,466	148,803
Connecticut	18,766	0	18,766
Rhode Island	1,584	0	1,584
Massachusetts	52,410	0	52,410
Vermont	0	432	432
New Hampshire	12,209	682	12,891
Maine	7,376	3,425	10,801
Total for the OTR	368,078	277,513	645,591
Electric Generating Units 15+ MW	277,994	221,337	499,331
Industrial Boilers 250+ MMBtu/hr	18,307	15,645	33,952
Other Industrial/ Institutional Boilers	35,288	27,669	62,957
Other Point Sources	36,489	12,862	49,351
Total for the OTR	368,078	277,513	645,591

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 11

2003 ANNUAL
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO B
(tons/year)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	55,737	188,070	243,807
Maryland	58,806	4,604	63,410
Delaware	18,680	0	18,680
Virginia (portion)	2,755	0	2,755
District of Columbia	1,217	0	1,217
New Jersey	53,081	0	53,081
New York	71,742	68,429	140,171
Connecticut	17,532	0	17,532
Rhode Island	1,499	0	1,499
Massachusetts	49,311	0	49,311
Vermont	0	425	425
New Hampshire	11,692	675	12,367
Maine	6,873	3,351	10,224
Total for the OTR	348,925	265,554	614,479
Electric Generating Units 15+ MW	260,013	210,011	470,024
Industrial Boilers 250+ MMBtu/hr	17,135	15,012	32,147
Other Industrial/ Institutional Boilers	35,288	27,669	62,957
Other Point Sources	36,489	12,862	49,351
Total for the OTR	348,925	265,554	614,479

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 12

2003 ANNUAL
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO C
(tons/year)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	55,737	179,387	235,124
Maryland	58,806	4,438	63,244
Delaware	18,680	0	18,680
Virginia (portion)	2,755	0	2,755
District of Columbia	1,217	0	1,217
New Jersey	53,082	0	53,082
New York	71,742	65,389	137,131
Connecticut	17,533	0	17,533
Rhode Island	1,499	0	1,499
Massachusetts	49,311	0	49,311
Vermont	0	418	418
New Hampshire	11,692	668	12,360
Maine	6,874	3,221	10,095
Total for the OTR	348,928	253,521	602,449
Electric Generating Units 15+ MW	260,015	198,684	458,699
Industrial Boilers 250+ MMBtu/hr	17,136	14,306	31,442
Other Industrial/ Institutional Boilers	35,288	27,669	62,957
Other Point Sources	36,489	12,862	49,351
Total for the OTR	348,928	253,521	602,449

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 13

2003 ANNUAL
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO D
(tons/year)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	57,152	188,060	245,212
Maryland	60,647	4,543	65,190
Delaware	19,168	0	19,168
Virginia (portion)	2,847	0	2,847
District of Columbia	1,153	0	1,153
New Jersey	53,268	0	53,268
New York	66,253	67,088	133,341
Connecticut	16,779	0	16,779
Rhode Island	1,412	0	1,412
Massachusetts	48,386	0	48,386
Vermont	0	410	410
New Hampshire	11,779	661	12,440
Maine	6,691	3,121	9,812
Total for the OTR	345,535	263,883	609,418
Electric Generating Units 15+ MW	256,989	208,687	465,676
Industrial Boilers 250+ MMBtu/hr	16,769	14,665	31,434
Other Industrial/ Institutional Boilers	35,288	27,669	62,957
Other Point Sources	36,489	12,862	49,351
Total for the OTR	345,535	263,883	609,418

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 14

1990 PEAK OZONE DAY
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
(lb/day)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	1,088,603	2,749,285	3,837,888
Maryland	1,079,930	103,864	1,183,794
Delaware	384,315	0	384,315
Virginia (portion)	91,547	0	91,547
District of Columbia	38,009	0	38,009
New Jersey	1,270,252	0	1,270,252
New York	1,675,350	1,035,920	2,711,270
Connecticut	309,868	0	309,868
Rhode Island	70,847	0	70,847
Massachusetts	1,666,725	0	1,666,725
Vermont	0	81,714	81,714
New Hampshire	198,825	4,857	203,682
Maine	100,104	26,425	126,529
Total for the OTR	7,974,375	4,002,065	11,976,440
Electric Generating Units 15+ MW	7,288,617	3,541,977	10,830,594
Industrial Boilers 250+ MMBtu/hr	152,988	155,999	308,987
Other Industrial/ Institutional Boilers	264,549	203,574	468,123
Other Point Sources	268,221	100,515	368,736
Total for the OTR	7,974,375	4,002,065	11,976,440

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 15

1995 PEAK OZONE DAY
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
(lb/day)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	762,063	1,946,183	2,708,246
Maryland	765,198	72,705	837,903
Delaware	274,560	0	274,560
Virginia (portion)	64,082	0	64,082
District of Columbia	26,606	0	26,606
New Jersey	906,048	0	906,048
New York	1,226,072	776,072	2,002,144
Connecticut	239,225	0	239,225
Rhode Island	49,593	0	49,593
Massachusetts	1,288,312	3120	1,288,312
Vermont	0	57,199	57,199
New Hampshire	139,178	3,647	142,825
Maine	80,771	18,499	99,270
Total for the OTR	5,821,708	2,874,305	8,696,013
Electric Generating Units 15+ MW	5,327,044	2,550,018	7,877,062
Industrial Boilers 250+ MMBtu/hr	107,091	109,201	216,292
Other Industrial/ Institutional Boilers	185,912	142,648	328,560
Other Point Sources	201,661	72,438	274,099
Total for the OTR	5,821,708	2,874,305	8,696,013

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 16

2003 PEAK OZONE DAY
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO A
(lb/day)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	453,659	951,182	1,404,841
Maryland	415,823	32,381	448,204
Delaware	140,697	0	140,697
Virginia (portion)	48,693	0	48,693
District of Columbia	25,353	0	25,353
New Jersey	481,512	0	481,512
New York	972,231	461,246	1,433,477
Connecticut	174,837	0	174,837
Rhode Island	29,722	0	29,722
Massachusetts	584,831	0	584,831
Vermont	0	41,288	41,288
New Hampshire	50,943	3,636	54,579
Maine	57,724	17,687	75,411
Total for the OTR	3,436,025	1,507,420	4,943,445
Electric Generating Units 15+ MW	2,986,417	1,224,906	4,231,323
Industrial Boilers 250+ MMBtu/hr	62,035	47,428	109,463
Other Industrial/ Institutional Boilers	185,912	142,648	328,560
Other Point Sources	201,661	72,438	274,099
Total for the OTR	3,436,025	1,507,420	4,943,445

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 17

2003 PEAK OZONE DAY
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO B
(lb/day)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	370,889	786,415	1,157,304
Maryland	329,241	27,518	356,759
Delaware	109,589	0	109,589
Virginia (portion)	37,071	0	37,071
District of Columbia	19,478	0	19,478
New Jersey	394,380	0	394,380
New York	756,638	382,914	1,139,552
Connecticut	136,728	0	136,728
Rhode Island	22,701	0	22,701
Massachusetts	455,826	0	455,826
Vermont	0	35,394	35,394
New Hampshire	40,134	3,562	43,696
Maine	45,126	16,796	61,922
Total for the OTR	2,717,801	1,252,599	3,970,400
Electric Generating Units 15+ MW	2,281,768	998,069	3,279,837
Industrial Boilers 250+ MMBtu/hr	48,460	39,444	87,904
Other Industrial/ Institutional Boilers	185,912	142,648	328,560
Other Point Sources	201,661	72,438	274,099
Total for the OTR	2,717,801	1,252,599	3,970,400

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 18

2003 PEAK OZONE DAY
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO C
(lb/day)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	370,889	621,502	992,391
Maryland	329,241	22,583	351,824
Delaware	109,589	0	109,589
Virginia (portion)	37,071	0	37,071
District of Columbia	19,478	0	19,478
New Jersey	394,380	0	394,380
New York	756,638	304,541	1,061,179
Connecticut	136,728	0	136,728
Rhode Island	22,701	0	22,701
Massachusetts	455,826	0	455,826
Vermont	0	29,501	29,501
New Hampshire	40,134	3,488	43,622
Maine	45,126	15,169	60,295
Total for the OTR	2,717,801	996,784	3,714,585
Electric Generating Units 15+ MW	2,281,768	751,233	3,033,001
Industrial Boilers 250+ MMBtu/hr	48,460	30,465	78,925
Other Industrial/ Institutional Boilers	185,912	142,648	328,560
Other Point Sources	201,661	72,438	274,099
Total for the OTR	2,717,801	996,784	3,714,585

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 19

2003 PEAK OZONE DAY
STATIONARY SOURCE* NO_x EMISSIONS IN THE OTR
ASSUMING BUDGET SCENARIO D
(lb/day)

	Budget Zone 1	Budget Zone 2	Total OTR
Pennsylvania	373,528	786,277	1,159,805
Maryland	325,590	23,866	349,456
Delaware	107,216	0	107,216
Virginia (portion)	31,864	0	31,864
District of Columbia	13,776	0	13,776
New Jersey	372,239	0	372,239
New York	535,783	301,432	837,215
Connecticut	103,880	0	103,880
Rhode Island	15,679	0	15,679
Massachusetts	369,866	0	369,866
Vermont	0	23,608	23,608
New Hampshire	41,449	3,414	44,863
Maine	36,553	13,823	50,376
Total for the OTR	2,327,423	1,152,420	3,479,843
Electric Generating Units 15+ MW	1,893,121	902,569	2,795,690
Industrial Boilers 250+ MMBtu/hr	46,729	34,765	81,494
Other Industrial/ Institutional Boilers	185,912	142,648	328,560
Other Point Sources	201,661	72,438	274,099
Total for the OTR	2,327,423	1,152,420	3,479,843

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

TABLE 20

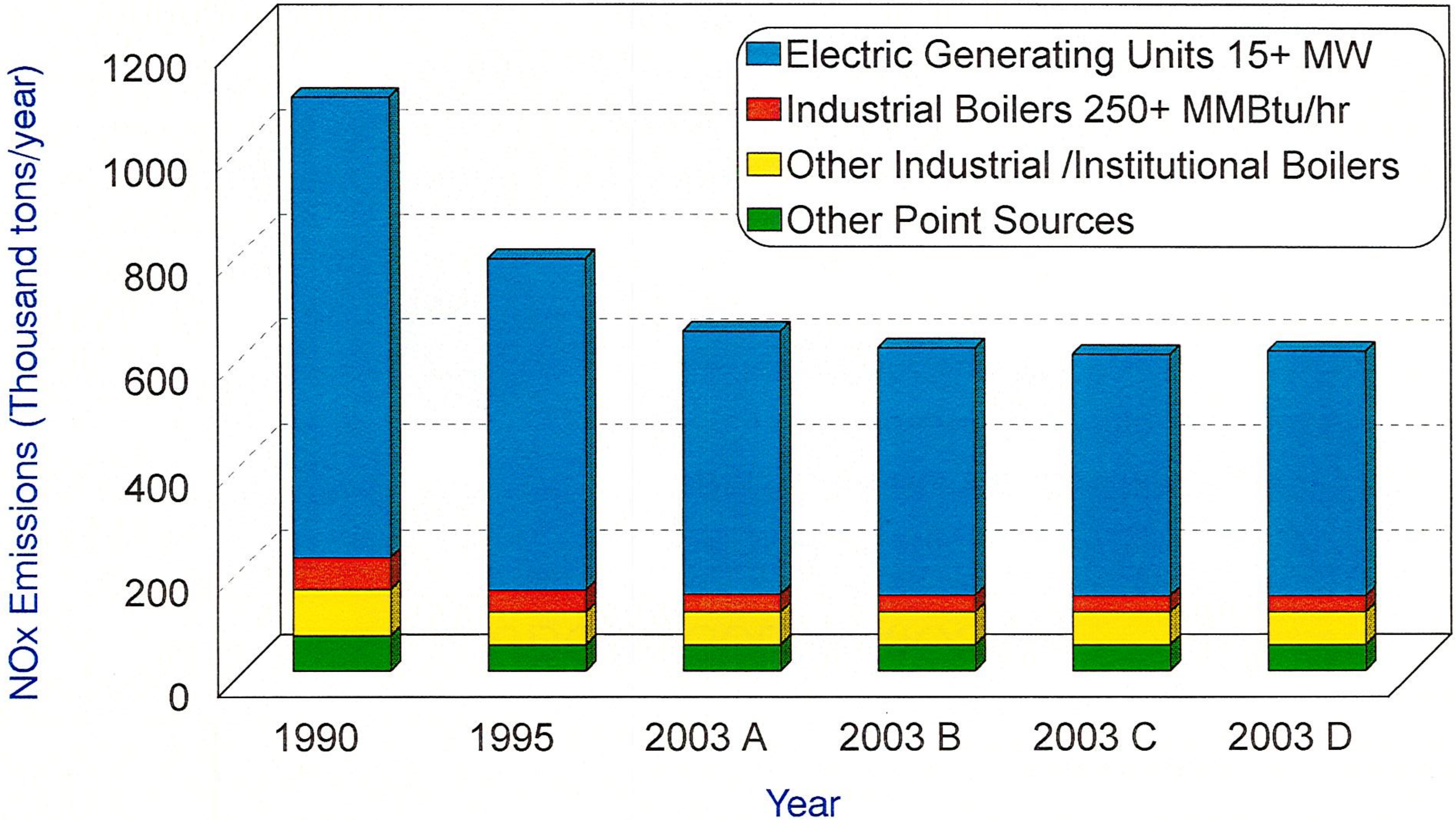
SUMMARY OF POSSIBLE STATIONARY SOURCE* NO_x REDUCTIONS IN 2003 UNDER HYPOTHETICAL BUDGET SCENARIOS A, B, C AND D RELATIVE TO 1990 BASELINE EMISSIONS

Time Period/Geographical Area	A	B	C	D
<u>Peak Ozone Day</u> (lb/day)				
Budget Zone 1	57%	66%	66%	71%
Budget Zone 2	62%	69%	75%	71%
OTR Total	59%	67%	69%	71%

* Includes sources with actual 1990 NO_x emissions of 25 tons or more.

FIGURE 8

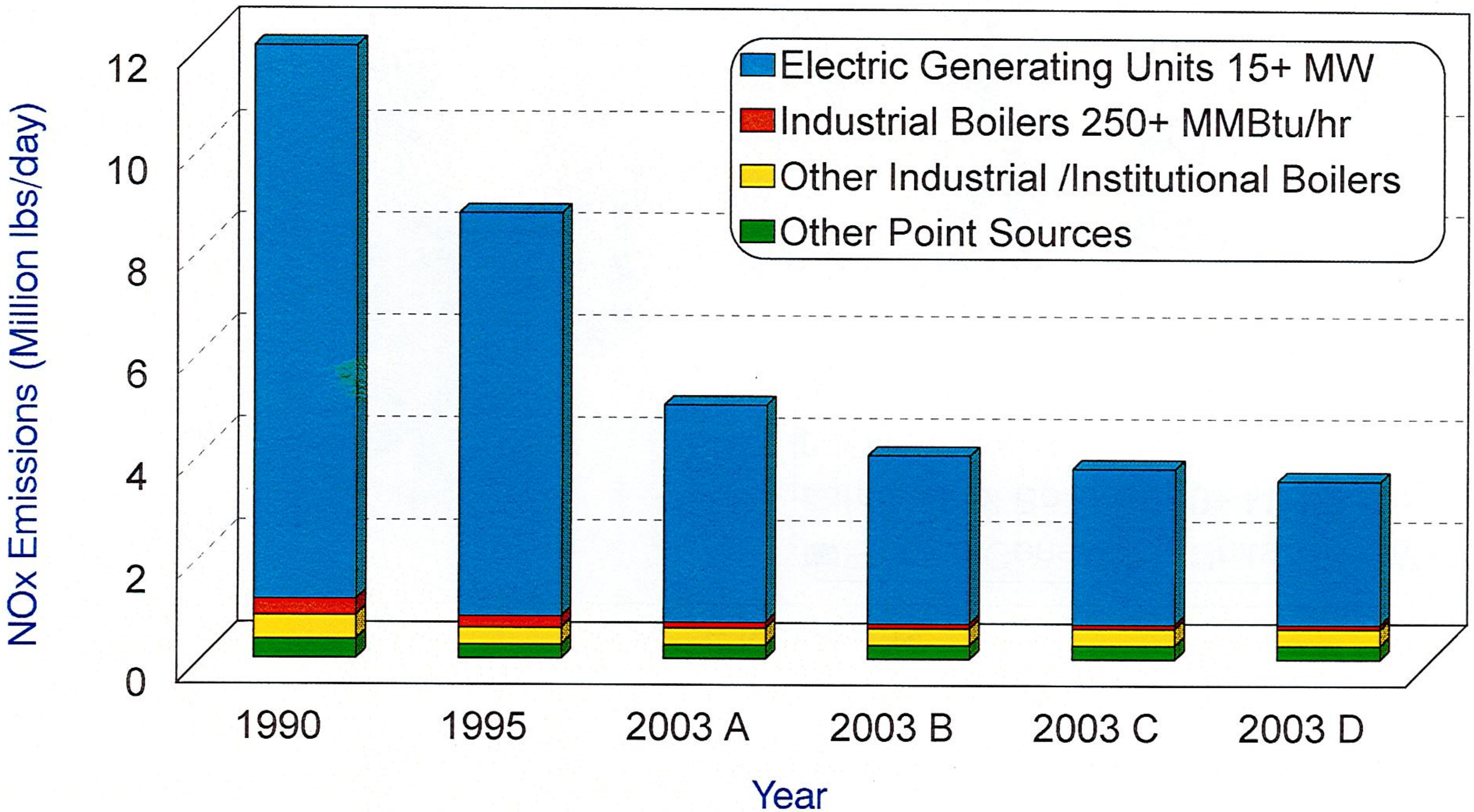
PROJECTED ANNUAL STATIONARY SOURCE* NOx EMISSIONS IN THE OTR UNDER FOUR BUDGET SCENARIOS



* Includes sources with actual 1990 NOx emissions of 25 TPY or more

FIGURE 9

PROJECTED PEAK OZONE DAY STATIONARY SOURCE* NOx EMISSIONS IN THE OTR UNDER FOUR BUDGET SCENARIOS



* Includes sources with actual 1990 NOx emissions of 25 TPY or more

8.0 COMPATIBILITY OF THE PROPOSED NO_x BUDGET SYSTEM WITH EPA's ECONOMIC INCENTIVE PROGRAM RULES

An Economic Incentive Program (EIP) is the most flexible mechanism available at the federal level for implementing an interstate air pollution control program consistent with the requirements of the CAAA. For that reason, the essential requirements of such an EIP under EPA rules[7] have been included in the guiding principles of this study (see Items 5 and 6 in Chapter 3.0). The objective of this chapter is to discuss the compatibility of the proposed NO_x budget system with a discretionary EIP, i.e., one not required by the CAAA but voluntarily adopted by states to reduce emissions in nonattainment areas. For discretionary EIP's, EPA's recently published rules[7] only represent guidance, not absolute requirements, regarding the elements of an EIP. From a review of this guidance a list of the essential EIP elements has been compiled and these are discussed in the sections below. This discussion does not cover every detail of the EIP that will need to be written to implement the NO_x budget system. Code references to 40 CFR 51 Subpart U are given in each section.

8.1 Program Scope

Section 51.493(b)(1) requires that an EIP clearly define the sources affected by the program. This includes both the type and size of sources, as well as the geographic areas included in the program. This element is satisfied by the program parameters: Affected Sources (report Section 5.1), Budget Zones (report Section 5.9), and Trading Area (report Section 5.10).

Subsection (i) requires that the definition of sources address whether the program is mandatory or voluntary. The NO_x budget system will be mandatory for the Affected Sources.

Subsection (ii) requires that provisions, if any, by which sources that are not required to be in the program may voluntarily join be identified. This is addressed, at least in part, by the provisions that allow sources not in the NO_x emissions budget program to buy allowances for use as emission offsets (report Section 5.8) and by the program parameter ERC Interface (report Section 5.15).

Subsection (iii) requires that provisions, if any, by which sources covered by the program may voluntarily leave be identified. Affected Sources will not have the option to leave the NO_x budget system except in the possible case that the Affected Source is shutdown, the owner or operator ceases to have any operating facility within the OTR, and the right to receive allowances is sold or otherwise transferred to another person.

Section 51.493(b)(2) requires that any opt-in provisions shall be designed to ensure that there is no increase in areawide emissions from the voluntary entry of sources into the program. This is satisfied by the fact that the NO_x budget system will use a mass emission budget for defined areas that will be fixed and declining with time. Opt-in of New Sources is only envisioned for sources within the defined Budget Zone(s). Allowing sources outside the OTR to opt-in to the NO_x budget system would appear to violate this provision of the EIP rules unless the geographic area it is located in (e.g., Ohio) was first added to the defined Budget Zone.

8.2 Program Baseline

Section 51.493(c) requires that a program baseline be defined for projecting program results and initializing the emission budget and allowance trading system. This element is satisfied by the parameters Baseline Activity Measure (report Section 5.4.1) and Budget Emission Rate (report Section 5.4.2).

Subsection (5) requires that the baseline for individual sources be contained in a federally-enforceable operating permit. As discussed in report Section 6.4, each Affected Source is a part of a facility that will have a Title V Operating Permit. The regulatory limits and responsibilities on Affected Sources will be written into those Operating Permits.

8.3 Replicable Emission Quantification Methods

Section 51.493(d) requires that there be credible, workable, and replicable methods for quantifying emissions from individual sources. This element is satisfied by the requirement that each Affected Source install and operate a CEMS (see report Section 6.4).

Subsection (2) requires that the averaging time for the mass emissions cap be consistent with attaining and maintaining the ozone NAAQS and meeting RFP requirements. It also requires that if the averaging time for a mass emissions cap is longer than 24 hours that the state shall provide, in support of their SIP submittal, a statistical showing that the specified averaging time is consistent with attaining the ozone NAAQS and satisfying RFP requirements on a typical summer day basis. While the statistical method has not yet been developed, this element is covered by the discussion of the parameter Daily Limit (report Section 5.3) and in the listing of technical issues needing further work (report Section 6.2.2).

Subsection (3) requires proper accounting for shutdowns and production curtailments to ensure that associated emission reductions are not double-counted in the SIP and to account for any shifted demand. This element is satisfied by the parameters Shutdown Units (report Section 5.13), Moth-Balled Units (report Section 5-12), and New Sources (report Section 5.7). Since the NO_x budget system will cap all utility and nonutility generator NO_x emissions in the OTR, shutdown emission reductions can not shift to another generator in the OTR. Construction of new units will require the owners to purchase NO_x Allowances from the existing budget. A discussion of New Source start-up is given in the parameters New Sources (report Section 5.7) and Emission Offsets (report Section 5.8).

8.4 Source Requirements

Section 51.493(e) requires that the NO_x mass emissions limit imposed on each facility be readily ascertainable at all times, i.e., that the NO_x Allowances a facility holds for a given year be known at all times. This element is satisfied by the central registry for tracking the allocation, use, trading, and Banking of NO_x Allowances (report Section 6.5).

Subsection (2) requires adequate monitoring, recordkeeping and report requirements. This element is satisfied by the decision to require CEMS (report Section 6.4) for every Affected Source and to use the monitoring, recordkeeping and reporting requirements in the source's Title V Operating Permit.

8.5 Projected Results and Audit/Reconciliation Procedures

Section 51.493(f)(1) requires that procedures be specified for reconciling the program with the SIP RFP and attainment demonstration. The modeling demonstration for attainment will be based on the projected statewide total of 24-hour typical summer day NO_x emissions (statistically projected from the seasonal NO_x budget) for each future year. The effects of allowance trading are expected to be small (report Section 2.3, item 6) and can be accounted for by the program uncertainty factor in the EIP. The emissions reductions provided by the NO_x budget system will be an integral part of the SIP. The issue of projecting 24-hour reductions from the seasonal NO_x budget is discussed in the parameter Daily Limit (report Section 5.3) and as a technical issue needing further work (report Section 6.2.2).

Subsection (2) requires the use of two uncertainty factors in the EIP, and subsection (3) requires periodic program audits. While values for the uncertainty factors have not yet been developed, the states will perform an annual program audit and will implement reconciliation procedures if the audit indicates that the actual daily emission reductions are less than the projected emission reductions (see report Section 5.3).

8.6 Implementation Schedule

Section 51.493(g) requires that the EIP contain a schedule for adoption and implementation of all state commitments and source requirements in the program. While the schedule will be finalized at a later date, this element is preliminarily addressed by Target Program Start-Date (report Section 5.5.1) and Target End-Date (report Section 5.5.2).

8.7 Administrative Procedures

Section 51.493(h) requires that the program describe the administrative procedures for implementing the NO_x budget system, including funding. While these procedures are yet to be developed, this element is covered by the discussions of Administration (report Section 6.5).

8.8 Enforcement Mechanisms

Section 51.493(i) requires the EIP to establish effective procedures for enforcement, including penalties for noncompliance. While these mechanisms are yet to be developed, this element is covered by the discussion of Enforcement (report Section 6.4).

9.0 ANALYSIS OF THE PROPOSED NO_x BUDGET DESIGN VERSUS A COMMAND AND CONTROL ALTERNATIVE

Before discussing the relative merits of a regional, market-based emissions budget approach to emission control, it is useful to first discuss how command and control regulations work. Command-and-control regulations require that all units in a given class meet the same emission rate limits, regardless of the cost. This has been the traditional regulatory approach used to achieve environmental goals. This approach has the advantage of being clear and relatively easy to enforce. However, holding all facilities to the same reduction target can be disproportionally expensive for some sources. The true costs of controlling emissions vary greatly between facilities, and may vary even within the same facility between pieces of equipment. When the focus is on conforming to fixed standards, no financial incentive exists for firms to exceed their control targets. In fact, a firm that does so is often "rewarded" by being held to stricter emission limits than a firm that does not. There is no benefit to the firm for having invested in additional or innovative controls. Furthermore, while command-and-control regulations set a limit for the air contaminant emissions that may be released from any one unit during a given time period, they do not limit how much such units may be operated. Therefore they do not put any certain limit on the total amount that may be emitted. Nonetheless, command and control regulations have proven to be a generally effective, but not necessarily very efficient, means of dealing with regional pollution problems.

A regional NO_x emission budget does, in contrast, establish firm limits for the tons of a precursor pollutant released into the atmosphere from the regulated sources. Combined with market trading of NO_x Allowances a regional NO_x emission budget system provides a mechanism by which overall compliance costs for Affected Sources are reduced. Reduced compliance costs can also be obtained under a traditional command and control alternative to the proposed NO_x budget program if the command and control regulatory program pairs a NO_x emission rate limit with the trading of Emission Reduction Credits (ERC's). ERC's are distinctly different from NO_x Allowances in that an ERC is only created when a facility owner convinces a regulatory agency that a source has reduced its emissions and that this claimed reduction is real, surplus, enforceable, permanent, and quantifiable.

This chapter discusses some of the advantages of the proposed NO_x budget/allowance trading system over a rate limit/ERC trading alternative. It is assumed that both alternatives would regulate NO_x emissions only during the ozone season.

In 1994, EPA provided guidance to the states in response to the mandates in Title I of the Clean Air Act for EPA to issue Economic Incentive Program (EIP) rules. The EIP rules provide guidance to the states on the use of market-based approaches to achieve equivalent emission reductions in a more cost-effective manner than would be realized using more traditional command and control approaches. EPA's introduction to the EIP rules states:

> *"... the Agency hopes these rules and guidance will stimulate the adoption of incentive-based, innovative programs, where appropriate, that will assist states in meeting air quality management goals through flexible approaches which benefit both the environment and the regulated entities, allow for less costly control strategies, and provide stronger incentives for the development and implementation of pollution prevention measures and innovative emissions reductions technology."*[7]

A NO_x emission budget system with allowance trading would address the mandate of the Clean Air Act to implement measures sufficient to allow the region to achieve the NAAQS for ozone by limiting the amount of NO_x released into the atmosphere on a seasonal basis. Both a NO_x emission budget system and NO_x emission rate limit combined with ERC trading would qualify as economic incentive programs and would need to be established in accordance with the EIP rules.

While the two methods each regulate NO_x emissions while providing a market component, they differ in two important ways:

1) the method of establishing the annual emission limit:

   - emission rate limit, applied to an individual unit (emission rate program);
   - mass emission limit, applied to a region (emission budget program);

and

2) the type of market mechanism used to provide cost effective compliance and flexibility in achieving the limit:

   - ERC trading (emission rate program);
   - Allowance trading (emission budget program)

Emission rate limit versus mass emission limit.

An emission rate limit on affected units requires that the emissions produced from those units not exceed the required rate, typically given in pounds of NO_x emitted per million Btu. States may seek to lower emissions by decreasing the allowed emission rate. However, in response to increased product demand, an owner or operator of a facility may increase fuel input to a unit so that it may operate at a higher level of productivity or increase the number of such units in operation. With an emission rate limit, facilities can increase operations so long as the rate limit is not exceeded. As a result, total regional emissions may increase (or reduce their emissions less than anticipated) even though the regulated units comply with the new, more stringent rate limit.

A mass emission limit identifies the total amount of pollution that may be emitted during a specified period of time, such as pounds of NO_x per day or tons per ozone season. The total emissions from all regulated units is prohibited from exceeding this mass emissions limit. This approach provides greater certainty that the total emissions released from all regulated units will not exceed the mass emissions limit. Also because the mass emission limit is assigned to a group of units, not just a single unit, this approach may in some cases provide more flexibility to Affected Sources in how compliance is achieved.

Allowances versus ERC's

NO_x Allowances represent emission authorizations issued by the state (or other central agency) on an annual basis. In the presence of a declining NO_x emission budget, the number of allowances issued each year decreases. The total number of allowances for any year included in the NO_x emission budget program can be calculated at any time.

ERC's differ from allowances in that ERCs are only created when a facility owner proves to a regulatory agency that a unit has reduced its emissions below a baseline level and that this claimed reduction is real, surplus, enforceable, permanent and quantifiable.

This chapter compares the differences between the proposed system of a NO_x emission budget with allowance trading versus a system based upon an emission rate limit with ERC trading. Five criteria are used to illustrate the economic and environmental differences between the two approaches as a mechanism for reducing NO_x emissions in a region including a large and diverse population of sources.

1. **Economic Effects on Industry.** A NO_x emission budget system with allowance trading and an emission rate limit program with ERC trading both offer more flexibility in compliance. Because both approaches contain a market mechanism in their respective trading provisions, both encourage excess reduction to occur at those facilities where it is most cost effective. Trading of NO_x Allowances or ERC's may occur between sources at different facilities. This will result in lower capital costs, operating costs and greater operating flexibility for the group of Affected Sources.

Rate payers and shareholders in the companies will benefit from the lower costs as well. However, to the extent that an emission rate limit program with ERC trading, allows compliance to occur through extending operating hours or increasing capacity utilization, rather than by reducing emissions by the amount that would otherwise be required, the emission rate program may appear to be less stringent for industry. However, failure to achieve the targeted emission reductions would, pursuant to the EIP rules, result in the implementation of reconciliation procedures which will increase the stringency of the regulatory burden on the regulated units or other emission sources. To prevent this from occurring in an ERC trading system, a case-by-case regulatory review must be completed to ensure that ERC's are surplus before they may be traded in an emission rate limit program. The administrative burden of this review process imposes additional costs on facilities who seek to trade ERCs.

2. **Economic Effects on Government.** While both approaches require government resources to administer, trading for the NO_x budget system will be on balance easier and less costly to administer. However, a NO_x emission budget with allowance trading will have the high administrative demand initially required to implement the system. With an allowance trading system, the issues of baseline and source growth only have to be faced once at the beginning of the program. With ERC trading, these issues must be re-examined in each trade. The work of the NESCAUM/MARAMA Emissions Trading Demonstration Project has addressed the need for a detailed protocol developed in advance for each type of ERC. Approval of these protocols must be negotiated with each state agency that is administering the ERC trading program.

3. **Economic Development Effects.** A NO_x budget system with allowance trading will provide a large reservoir of NO_x allowances that can be purchased to satisfy emission offset

requirements for New Sources anywhere in the OTR and encourage economic development. An ERC trading system with an emission rate limit could also create a reservoir of NO_x credits. However, many of the sources of credits currently under discussion would produce discrete credits, applicable for a limited time. It is uncertain whether such credits could be satisfactorily used for emission offsets.

4. **Tendency to Encourage Innovation in Pollution Control**. EPA in its recently released Technology Innovation Strategy states:

> *"Technology innovation is indispensable to achieving our national and international environmental goals. Available technologies are inadequate to solve many present and emerging environmental problems or, in some cases, too costly to bear widespread adoption. Innovative technologies offer the promise that the demand for continuing economic growth can be reconciled with the imperative of strong environmental protection."*[14]

In discussing the market-based approaches to attainment encouraged by the 1990 Clean Air Act Amendments, the EPA Administrator recently stated that she intends to move EPA:

> *"beyond command and control ... to allow for greater flexibility, for common sense, for innovation in how we achieve those standards."*[15]

A NO_x budget/allowance system with allowance trading will encourage innovation in pollution control since no limits are placed in advance on the means of achieving NO_x reductions. An emission rate limit with ERC trading may promote innovative pollution control as well by creating a market for the purchase and sale of ERC's. However, the effectiveness of an ERC program in encouraging innovation will be impeded by the need in each case of demonstrating convincingly to state regulators the efficacy of the innovative technique, before credit can be given.

5. **Certainty of Achieving Reduction Goals Expeditiously.** A NO_x budget with allowance trading by definition provides certainty of attaining target reductions since it is based on the allocation of a fixed total of emission authorizations by the states to sources. By contrast, under an emission rate limit with ERC trading, it is possible to exceed the target level of emissions while still complying with the requirements of the approach.

Because the OTR includes a wide range of emission sources, many of whom would not be included in a NO_x emissions budget system, air quality improvements through market-based approaches can be best achieved when both mechanisms, allowance trading and ERC trading, are in place. A NO_x emission budget with allowance trading can provide a market mechanism that provides flexibility with high environmental certainty to a limited number of large emission sources, while a large number of smaller emission sources can provide some additional reductions with high flexibility using an emission rate limit with ERC trading.

10.0 CONCLUSION: RECOMMENDATIONS TO STATE AIR DIRECTORS

Through a consultative process involving the states and affected stakeholders, a conceptual design for a NO_x budget system has been created based on setting seasonal (five-month ozone season) mass emission limits for large stationary sources. This system will provide the states with an innovative, cost-effective approach for achieving NO_x emission reductions. The budget will be allocated in the form of NO_x Allowances to the Affected Sources: all electric generating units with a rated output of 15 MW or more and all industrial boilers with a heat input of 250 MMBtu/hr or more. Allowances will be marketable emission authorizations, meaning they may be bought, sold, or traded. Provisions are included that encourage re-powering and provide a supply of allowances for New Sources, including any requirements for emission offsets under New Source Review. It is recommended that all of the OTR be included in the NO_x budget system.

A review of technologically feasible NO_x control methods for the Affected Sources reveals that today's retrofit technology can achieve NO_x emission rates at or below 0.10 MMBtu in most cases. SCR in combination with combustion controls has been demonstrated to lower NO_x emissions for coal-fired boilers down to 0.05 lb/MMBtu, for oil- and gas-fired boilers down to 0.02 lb/MMBtu, and for gas turbines down to 0.03 lb/MMBtu.

In five areas analyzed in this report, the proposed NO_x budget and allowance trading system offers distinct advantages for large stationary sources of NO_x over a traditional, command and control alternative using emission rate limits and emission reduction credit (ERC) trading. These advantages are in the areas of:

- economic effects on electric generators and industry;
- economic effects on government;
- economic development effects;
- encouraging innovation in air pollution control; and

- the certainty of achieving emission reduction goals in an expeditious manner.

As part of this study, an emissions data base for all affected stationary sources in the OTR was assembled from EPA's 1990 Interim Emission Inventory. The EPA data were projected to 1995 and 2003. The analysis demonstrated that a NO_x budget based on an average emission rate across the OTR of 0.15 lb/MMBtu, would produce peak ozone day NO_x reductions of about 70% relative to a 1990 baseline. Substantial annual emission reductions would also occur.

The proposed NO_x budget system would be implemented through a discretionary EIP in the SIP's of the states in the OTR. Administration will require the involvement of both the states and a regional organization such as EPA or the OTC.

In conclusion, a regional, market-based NO_x budget program for stationary sources in the OTR states is feasible and will provide needed NO_x reductions in a flexible, cost-effective way that helps the states meet their obligations under the Clean Air Act.

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APPENDIX A

NO_x BUDGET ISSUE PAPERS

#1 Critical Review of Other Emissions Budget and Trading Programs

#2 Transport of Ozone and Ozone Precursors

#3 Power Pools

#4 Establishing a Baseline

#5 Budget Regions and Affected Sources

FEASIBILITY OF A REGIONAL NO_x BUDGET SYSTEM

CRITICAL REVIEW OF OTHER EMISSIONS BUDGET AND TRADING PROGRAMS

Issue Paper #1

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Version 4

1.0 INTRODUCTION

Emissions trading in conjunction with a NO_x budget for the Northeast States has received increased attention as a strategy for post-RACT NO_x emission reductions at stationary sources. The NO_x budget is a clear concept that addresses the final requirement for ozone compliance: limiting the tons of pollutant released into the atmosphere. Emissions trading is the mechanism for reducing overall compliance costs within a NO_x budget. Trading allows one emission source to over-control and trade excess allowances or credits to another plant that under-controls. When trading is encouraged, the allowances begin to resemble a commodity and market forces work to ensure that pollution control costs are minimized. Regional NO_x emissions trading, in conjunction with a NO_x budget cap will provide advantages to the Northeast States in their ozone control plans.

For this issue paper, seven existing trading programs are reviewed and discussed with respect to a regional budget system. Particular emphasis is afforded the federal Title IV acid rain program due to its widespread geographical impact and general acknowledgement as a successful program for capitalizing on the power of the marketplace. These budget and allowance trading programs are:

(1) Title IV (CAAA) Acid Rain Program
(2) SCAQMD RECLAIM Program
(3) SCAQMD Rule 1135
(4) Lead Phasedown in Gasoline
(5) Title VI (CAAA) CFC Phaseout Program
(6) Texas NO_x RACT Trading System
(7) Illinois NO_x Trading System.

2.0 TITLE IV ACID RAIN PROGRAM

Title IV of the CAAA of 1990 sets as its primary goal the reduction by the year 2010 of annual sulfur dioxide (SO_2) emissions by 10 million tons from 1980 levels. To achieve these reductions, the law requires a two-phase tightening of emission limits placed on fossil-fuel-fired power plants.

Phase I begins in 1995 and affects the 110 highest SO_2-emitting electric utility plants located in 21 eastern and midwestern states (coal plants only). Phase II, which begins in the year 2000, tightens the annual emissions limits imposed on these large, higher-emitting plants and also sets restrictions on smaller plants fired by coal, oil, and gas. The program affects existing utility units with an output capacity of 25 megawatts or greater, and all new utility units except those under 25 megawatts that use fuel with a sulfur content less than 0.05 percent.[1]

In addition to the 10 million ton reduction of SO_2, Title IV also requires a 2 million ton reduction in NO_x emissions by the year 2000. This will primarily be accomplished by requiring coal-fired utility boilers to install low NO_x burner technology and to meet new emission standards.

2.1 Structure of Acid Rain Program

To implement the statutory mandate in Title IV, the Acid Rain Program requirements are codified in seven regulations (40 CFR Parts 72-78) which contain the requirements for permitting, allowances, opt-in provisions, monitoring, NO_x reduction, enforcement, and appeals. Each part is listed below along with its current regulatory status.

Part	Part Name	FR Date	Status
72	Permits Regulation	1/11/93	Final
73	Allowance System	1/11/93	Final
74	SO_2 Opt-Ins	9/24/93	Proposed
75	Continuous Emission Monitoring	1/11/93	Final
76	Acid Rain NO_x Emission Reduction Program	3/22/94	Final
77	Excess Emissions	1/11/93	Final
78	Appeal Procedures for Acid Rain Program	1/11/93	Final

The most extensive of the acid rain proposals (Parts 72, 73, 75, 77, 78) were proposed on December 3, 1991 and are referred to as the "core rules". Prior to the publication of the "core rules", the US EPA solicited comments and ideas from potentially affected individuals and organizations. The Acid Rain Advisory Committee (ARAC) was formed for that purpose and included 44 members representing various stakeholder groups, including utilities, emissions control equipment vendors, State Public Utility Commissioners, academicians, coal and gas companies, State air pollution control agencies, labor, and environmental groups. The ARAC was divided into five subcommittees charged with developing options and responses to EPA issues. The subcommittees were identified as: Allowance Trading and Tracking, Permitting and Technology, Emissions Monitoring and Tracking, Energy Conservation and Renewable Energy, and Opt-In. The EPA feels that the input received through this advisory process prior to the proposed rule-making was critical to the successful development of the program.

2.2 Review of Key Acid Rain Program Subparts

2.2.1. Permits Regulation

The Acid Rain Program was required by federal law to be implemented through the Title V State Operating Permit program, except "as modified" by the requirements of Title IV (see Sections 408(a) and 506(b) of the Act). The Part 72 regulation established nationwide permitting for Title IV sources including standardized forms for permit applications, compliance plans, permits, and compliance certifications. This same level of consistency would be important for a regional NO_x budget system covering the OTR. Designating a representative for the owners and operators of each affected unit is a prerequisite to obtaining a permit. All submission of compliance plans, permits, and allowances must be made by this authorized person.

When it was proposed, EPA received many comments on Section 72.202(a), which bars a State operating permit program from interfering with the SO_2 allowance market. The majority of the comments supported Section 72.202(a) as proposed, saying the State interference with the allowance program would frustrate a crucial objective of Title IV: The achievement of nationwide emissions reductions at the least cost to utilities. In other words, the larger the universe covered by the allowance market, the more cost-effective the emissions reductions. However, a significant minority opposed this section, claiming it would limit a State's ability to protect legitimate interests, such as limiting the total deposition within the State and protecting national parks and forests.[2]

New York State recommended that all proposed trade allowances be reviewed for their impacts on acid deposition throughout the Northeast.[3] These comments were not reflected in the final rule released by EPA in January 1993, so New York and the Adirondack Council jointly filed suit on March 11, 1993 in the U.S. Court of Appeals for the D. C. Circuit, which is still pending. The EPA pointed out that the drafters of Title IV clearly contemplated a national program. Early Senate and House versions of the bill contained geographic limitations on allowance transfers that were dropped in later versions in favor of a national trading system.[3] A *de minimis* exemption was given for new utility units that serve one or more generators, the nameplate capacities of which total 25 MW or less, and that use fuels with a sulfur content of 0.05% or less by weight.

2.2.2. Allowance System

Allowance trading is the centerpiece of the Acid Rain Program, and allowances are the currency with which compliance with the SO_2 emissions requirements is achieved. One allowance authorizes a unit within an affected utility or industrial source to emit one ton of SO_2 during, or following a given year. At the end of each year, the unit must hold an amount of allowances at least equal to its annual emissions.

Allowances are allocated for each year of operation beginning in 1995. In Phase I, EPA allocates allowances to each unit using an emission rate equal to 2.5 pounds of SO_2 per million British Thermal units (lb/MMBtu) of heat input multiplied by the unit's baseline (the average fossil fuel consumed from 1985 through 1987). Phase II begins on January 1, 2000 and captures these large, higher emitting plants as well as smaller, cleaner plants fired by coal, oil, and gas. Phase II allocates allowances using an SO_2 emission rate equal to 1.2 lb/MMBtu multiplied by the baseline. Total SO_2 emissions in the US will be budgeted at 8.95 million tons per year beginning in the year 2000 for these affected units.

At the heart of the Allowance System are the three subparts B, C, and D which define Allowance Allocations, the Allowance Tracking System, and Allowance Transfers, respectively. The basic structure of each of the subparts was prescribed by Congress in the writing of Title IV thereby eliminating much of the state-by-state debate on various issues. Discussions with several people in the US EPA Acid Rain Division reveal that the Senate Committee Report on the Acid Rain Program contains valuable documentation on the issues debated by Congress in the crafting of the law.[4] Attempts to secure a copy of this report have been unsuccessful to-date.

The prescriptiveness of the Acid Rain Program is one of the reasons for its success. By putting the Phase I affected sources and their allowances directly into the law, Congress eliminated any debate among the US EPA and the States over this part of the program. This is a potential major stumbling block for the implementation of any NO_x budget in the OTR: there is no legislative mandate for the member states to follow. As a result, a parochial atmosphere is likely in which each state will feel it must protect its own interests. The Allowance System under Title IV was laid out so that the biggest issues were the resolving of minor administrative details such as the "allowance transfer deadline" which is the last day sources may transfer allowances for use in meeting a unit's subaccount for that year (January 30).

The acid rain budget/allowance program has been a large success as measured by the rapid decline in the average SO_2 allowance price (a measure of SO_2 control costs). Initially, the EPA made allowances available for a cost of $1,500 each. Early projections of the cost of an SO_2 allowance were in the range of $400. At the most recent auctions at the Chicago Board of Trade the price for an SO_2 allowance was approximately $150. One reason for this drop in price is that the allowances actually resemble a tradeable commodity. This is, they can be bought, sold, or banked for use in future years; the trading market is large geographically, and the rules for trading are very flexible. An alternative explanation is that low prices of allowances may reflect low demand, i.e., the unwillingness of utilities to rely on the purchase of allowances as a control strategy given their conservative nature and regulation by public utility commissions. Given that the acid rain program will not be in full operation until the end of the decade, final judgement on this issue may have to wait a few years.

3.0 SCAQMD RECLAIM PROGRAM

The South Coast Air Quality Management District (SCAQMD) is the local air pollution authority for the Los Angeles air basin. In an effort to depart from traditional command and control regulatory strategy, the SCAQMD staff developed the Regional Clean Air Incentives Market (RECLAIM) in four phases beginning October 1990. RECLAIM is based on the concept of bubbling stationary sources at the facility level, limiting total mass emissions from the facility, and requiring each source to meet prescribed annual facility emissions targets. The actual method of compliance is left up to the individual firm, including purchasing tradeable emissions, installing control equipment, using lower emitting material, or other techniques.

Originally conceived as an emissions trading program for VOC's, NO_x and SO_x, the final version of RECLAIM was adopted by the SCAQMD governing board in October 1993 to cover all major stationary sources of SO_x and NO_x with emissions generally greater than 4 tons/yr (VOC's may be added at a later date). The RECLAIM program is being implemented for the 369 affected facilities in two phases, with 155 of the facilities permitted by January 1, 1994 and the other 214 permitted by July 1, 1994.[5] The baseline for RECLAIM is the <u>potential</u> to emit in 1989. The problem with this baseline is that there are no certified reductions in <u>actual</u> emissions and the dirtiest sources, or those with excess unused capacity, are rewarded with the highest baselines. In the case of some utility units it has been suggested that actual emissions may even increase in the short-term due to the use of a potential emissions baseline. In addition, the program allocates allowances to defense contractors who are leaving the state, having shutdown their plants right after 1989. Counting past shutdowns and allocating allowances to non-existent sources may also cause actual emissions to increase in the near term.

The complexity and far-reaching impact of the RECLAIM program is apparent by the size of the Executive Summary which is 44 pages in length.[6] Each affected facility will receive an annual emissions allocation for sources emitting either NO_x or SO_x. Facilities will be required to meet specific annual mass emission reduction targets. The annual market rate of reduction for the SO_x sources will be 6.8% for the period 1994 through 2003. The annual market rate of reduction for the NO_x sources will be 8.3% for the period 1994 through 2003.[6] The annual allocations do not include SO_x emissions from equipment that burns natural gas exclusively. The trading market has been slow to develop with two registered trades as of May 1994 amounting to a total of 600 pounds of NO_x.[5] Trading is only allowed within a given year, i.e., there is no banking of emission allocations.

Preliminary indicators from the SCAQMD staff find that RECLAIM is being successfully implemented. Permits are being issued in a timely manner and a compliance rate of 93 percent is estimated. The SCAQMD credits a portion of the program's success to the cooperative working relationship between the agency and industry forged during the collaborative three year development of the RECLAIM rules. RECLAIM came to be only after an immense effort to reach consensus and years of planning. A NO_x budget system will be a larger and more complicated program (because of individual state SIP submittals) than RECLAIM.

4.0 SCAQMD RULE 1135

Five utilities in the Los Angeles basin have been subject to an emission budget system for the past ten years. The South Coast Air Quality Management District (SCAQMD) adopted Rule 1135 to cover Southern California Edison (SCE), Los Angeles Department of Water and Power (LADWP), and three small utilities (Glendale, Burbank, and Pasadena). Under the revised Rule 1135 (adopted July 19, 1991), SCAQMD adopted a systemwide NO_x emission rate of 0.15 lbs/MWh for SCE and LADWP, and 0.2 lbs/MWh for the three smaller utilities.[7] Systemwide averaging has provided the incentive for utilities to install SCR controls on units where it is most cost effective. Daily and annual mass emission budgets were also established for individual utilities. Effective January 1, 1994 this command and control rule was replaced by the RECLAIM program except for the 3 small utilities which were granted exemptions and allowed to continue under Rule 1135.

The units of the budget were set in pounds of NO_x per unit of electric output (MWh) which is a departure from the traditional limit of pounds of emissions per unit of heat input. By requiring that the emission budget be based on useful output of the system, utilities are encouraged to produce their electric output in the most efficient way possible in order to minimize their emissions for a given amount of output. This should give the five utilities additional incentive to consider low- and no-emission resources (solar, wind, geothermal, demand-side management, conservation) in their future resource plans.

5.0 LEAD PHASEDOWN IN GASOLINE

The 1979-to-1988 phasedown of leaded gasoline is frequently cited as an example of a successful market-based incentive pollution reduction measure. Because of concerns over adverse health effects from airborne lead, the US EPA required that unleaded gasoline be made available by July 1974 and restricted the lead content of leaded gasoline to 1.7 grams per leaded gallon (gplg) after January 1, 1975.[8] EPA established a limit of 1.1 gplg for leaded gasoline beginning July 1, 1985 and 0.1 gplg after January 1, 1986. A complete ban on lead in gasoline will take effect in 1996.

In order to meet tightening auto emission standards in the late 1970's, manufacturers began equipping new cars with catalytic converters. Since catalytic converters are poisoned by lead, their proliferation meant an increased demand for unleaded gasoline.[9] So while the US EPA was setting stringent levels for reduced lead in gasoline during the later 1970's and 1980's, market forces were also at work increasing the demand for unleaded gasoline to fuel new automobiles equipped with catalytic converters.

Beginning July 1, 1983, EPA allowed refiners and importers of gasoline to trade lead reduction credits to meet the limit for the average lead content of gasoline. Refiners and importers who reduced the average lead content of their gasoline below the EPA limit generated credits that could be sold to refiners or importers that exceeded the limit. Reporting was done on a quarterly basis; all credits generated in a quarter had to be used within that quarter.[8] In 1985, EPA allowed refiners to bank lead credits for use until the end of 1987. Between 1985 and 1987, up to 20 percent of total lead consumed passed through banking deals.[9]

Part of the success of this program is attributable to the relative simplicity and ease of administration and enforcement. Reporting forms for refiners and importers were simple and verifiable. The forms requested two lists: (1) the names of entities with which the refiner or importer traded and the quantities traded; and (2) a list of physical transfers of lead additives to or from entities other than lead additive manufacturers. Together, these data provided enough information to match individual purchases and sales of lead credits and to verify that total sales of lead rights equalled total purchases.[8]

Actual transaction prices for lead credits were known only to the market participants. No price reporting was made to EPA, only volumes traded. Intermediaries played a limited role in this market system. The EPA estimated that due to the banking alone, refiners saved over $220 million versus conventional regulations (command and control). By encouraging banking, more lead reductions occurred in the early years than would have occurred otherwise. This translated to a direct health benefit for the American people.

6.0 TITLE VI CFC PHASEOUT PROGRAM

Allowances to companies that produce or import ozone-depleting substances will be distributed according to final regulations issued by the US EPA on July 30, 1992.[10] These regulations were required by Title VI of the 1990 CAAA (Stratospheric Ozone Protection). The larger context of the ozone-depleting substance phaseout strategy arises from the Omnibus Reconciliation Act of 1990, the Montreal Protocol on Substances that Deplete the Ozone Layer (first signed in 1987), as well as the 1990 CAAA.[11] The strategy has four major components: (1) a marketable permits system; (2) an excise tax; (3) a program to ensure the safety of chemicals developed as substitutes for ozone-depleting substances; and (4) a recycling program.

The EPA's main task was to ensure the production and consumption of ozone-depleting chlorofluorocarbons (CFCs), and halons was limited and phased out according to the Montreal Protocol and the 1990 CAAA. The centerpiece of the strategy is the marketable permits system which is designed to use free market forces to direct users toward alternative chemicals. The key to its success is the limited universe of entities pulled directly into the regulation. Initially the EPA considered imposing emission limits on the various chemicals for each type of user. However, with over 10,000 different uses for these chemicals this process would quickly breakdown. The alternative was to regulate the manufacturers directly. With only five CFC and two halon manufacturers, EPA had a very manageable group of sources.[11]

The manufacturers were assigned production and consumption allowances based on the total volume of the five CFC chemicals covered by the regulations, each weighted by its ozone-depletion potential. The EPA assigned these allowances to each manufacturer for each chemical based on their actual 1986 production and import levels. Allowances are parcelled out each year in decreasing amounts according to the phaseout schedule prescribed by Section 604 of the CAAA. Allowances can not be carried over into the next control period. The CFCs must be reduced 50 percent by 1998 over the 1986 baseline levels and phased out completely by 2000 (2002 for methyl chloroform).

The intent of the program was to allow the most efficient companies to receive trades from less efficient producers who could not otherwise compete in the marketplace. Over the past several years, there have been many trades among companies to adjust for market and plant efficiencies.[11] Recordkeeping and reporting is relatively straightforward with producers, importers and transformers reporting quarterly, and exporters reporting annually.

7.0 TEXAS NO_x RACT TRADING PROPOSAL

The Texas Natural Resource Conservation Commission (TNRCC) proposed a NO_x trading regulation in February 1994 in order to provide NO_x RACT sources a "cost-effective alternative method of complying with the NO_x emission specifications of this chapter".[12] In Texas, the subject NO_x RACT sources include major NO_x sources in the Houston-Galveston-Brazoria ozone nonattainment area (classified as Severe-17) and the Beaumont-Port Arthur ozone nonattainment area (classified as Serious).

Under the trading program, an owner or operator may reduce the amount of NO_x emissions reductions otherwise required under Chapter 117 by obtaining an emission reduction credit. Emission reduction credits (ERCs) may only be generated by a source in the same federally designated ozone nonattainment area as the unit seeking to obtain ERCs. ERCs can only be generated by reductions at stationary sources after November 15, 1990. ERCs may be generated by sources not covered by the NO_x RACT rule. ERCs must be acquired by a source prior to their utilization, and for major NO_x sources these are calculated using actual daily heat input (MMBtu/day) multiplied by continuous operation (365 days/yr). Reduction credits are used to calculate a new 30-day rolling emission limit in either lb/day or lb/MMBtu.

The proposed rule outlines the system for administering the trading program, including a "specific timetable for the TNRCC to act on an application for an ERC. A source seeking to create ERCs must use a standard registration form created for this purpose. The trading system may never be used, however, if TNRCC receives approval from EPA on its May 4, 1994 request for waiver and exemption from all NO_x RACT rules under Section 182(f) of the Act.[16]

8.0 ILLINOIS NO_x TRADING SYSTEM

Compliance with the ozone standard may require onerous controls for major VOC and NO_x emission sources in the Chicago-Gary-Lake County nonattainment area of Illinois (classified as Severe-17). In June 1993 the Illinois EPA (IEPA) announced the development of a NO_x trading program. The IEPA formed a trading design team consisting of staff members from IEPA, Commonwealth Edison Company, the Environmental Defense Fund, Palmer Bellevue Corporation, and E3 Ventures. This collaborative effort produced a draft proposal for a NO_x emissions trading system in September 1993.[13]

Potential participants for the trading program were those facilities with 1992 actual emissions greater than 25 tons of NO_x during the ozone season (May 1 through September 15). After excluding small emission units (less than 5 tons of NO_x during the ozone season), approximately 298 emission units (63 sources) would be potential participants in the NO_x trading program.

It is proposed to allocate the total authorized seasonal NO_x emissions among the sources using a percentage of 1992 actual emissions adjusted for RACT. In addition, a small percentage (2% proposed) of the total NO_x emissions will be set aside for areawide market assurance, with all or some portion sold at an annual auction. The draft proposal concluded it would be best to bring the 12 largest sources (80% of emissions) together to develop the starting baseline, or areawide emissions "budget", which would be facilitated by the IEPA. The total NO_x reduction that is necessary will be determined by the regional attainment demonstration modeling. The proposed starting year for the trading would be 1996 or 1997.

The basic trading unit would be called a NO_x trading unit (NTU) equal to 200 pounds of NO_x emissions or one-tenth of a ton. Each NTU would be identified by a unique serial number and an issuance year, and NTU's could be used in that or future years. The shelflife of an NTU would be three years, unlike the acid rain program which does not put a shelflife on allowances. This was done out of fear that emissions "peaking" might occur if sizeable amounts of banked units came into service in one or two particular ozone seasons. The "first-in, first-out" rule would also apply where the oldest units are the first to get used.

Since the publication of the draft proposal for the NO_x trading system, the Lake Michigan Air Directors Consortium has concluded that reductions in NO_x actually could work against efforts to reach ozone attainment in areas bordering Lake Michigan.[14] These results, obtained through regional oxidant modeling (ROM), have led to the abandonment of the NO_x trading system in Illinois in favor of a VOC trading system.[15] The IEPA hopes to have a draft proposal out on this trading system by the end of the summer of 1994.

9.0 SUMMARY

Seven budget and allowance programs for reducing emissions were reviewed; five of these have some operating history. For the NO_x budget project which is not directly comparable to any of these programs, the purpose of this review was to identify the emissions trading elements that worked well and those that did not. Sulfur dioxide and lead are attainment pollutants and the programs for those pollutants are not constrained by the non-attainment laws and regulations that apply to NO_x in the OTR.

One lesson learned is that compliance costs declined rapidly and compliance goals were achieved early when the trading portion of a budget and allowance program was active. Active trading of allowances occurs when the allowance resembles a commodity, and this requires simple and flexible rules for buying, selling and banking allowances. In the case of the acid rain program, the sheer size of the budget area and the tons of pollutants in the program may have aided the establishment of a viable trading program. Thus, unless otherwise restricted, a budget program should be designed for as large an area or source population as possible.

A fuel independent allocation of allowances creates the need for more trading and should lead to lower control costs long-term for the regulated source population. No problems have developed so far in the acid rain program from the use of fuel independent rules in allocating SO_2 allowances. While the true fuel independent part of the program (Phase II) is yet to be implemented, utilities are already well along in their planning to meet Phase II. By contrast, in the RECLAIM program the use of past potential emissions as the baseline has created a situation where actual emissions could increase in the short-term at some sources. The declining budget in RECLAIM will however ensure emission reductions in future years. This suggests that allowances should in the long-term be allocated on a fuel independent basis in a NO_x budget program. Using one type of fuel independent measure, energy output (MW or lb steam/hr), in the budget program would encourage energy efficiency and reduce emissions of other pollutants.

In summary, the components of a budget and allowance program for NO_x that will encourage active emissions trading are summarized below, along with the potential disadvantages.

Component	**Regulatory Downside**
Large number of sources under the budget	Increased administrative costs
Large geographic area for trading	Coordination of SIP planning in many states
Banking of credits from year to year	Difficulty in tracking and proving emission reductions for the SIP
Fuel independent budget	Greater reliance on clean fuels during the control period.

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FEASIBILITY OF A REGIONAL NO_x BUDGET SYSTEM

TRANSPORT OF OZONE AND OZONE PRECURSORS

Issue Paper #2

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1.0 INTRODUCTION

Major episodes of high ozone concentrations in the eastern U. S. are associated with slow-moving, high pressure systems in the summer months. These meteorological conditions produce low mixing depths, light winds and hence a high degree of air stagnation. The associated warm temperatures and cloudless conditions are also favorable for photochemical ozone production from the precursor emissions of VOC and NO_x. High ozone episodes in the Ozone Transport Region (OTR) occur on scales of over 1,000 km and can persist for many days.[1] The OTR consists of the four mid-Atlantic States (PA, MD, DE, portions of northern VA), the District of Columbia, and the eight NESCAUM states (NJ, NY, CT, RI, MA, VT, NH, ME). Congress created the OTR as a single air quality planning region arguably because sources anywhere in the OTR contribute to ozone episodes. The occurrence of high ozone levels in rural and urban areas concurrently over a large portion of the eastern U. S. is due to the combination of: transport of ozone and precursor emissions into an area from other portions of the region, and the generation of ozone locally from sources in the local area.

The objectives of this paper are to address the following questions regarding a regional NO_x budget:

(1) What NO_x source locations affect the high ozone concentrations measured in excess of federal health standards throughout the OTR?

(2) Under a NO_x budget program, is there a justification for limiting the directionality of allowance trading?

(3) What limitations will Section 173 of the Clean Air Act (CAA) place on the design of a NO_x allowance trading system? (Section 173 (c)(1) of the CAA sets out the terms under which sources subject to New Source Review may trade emission reductions to satisfy the offset requirement.)

2.0 CAUSES OF OZONE EPISODES IN THE OTR

An ozone episode is defined[2] as an event when ozone levels exceed the federal health standard in two or more states for a period of two or more consecutive days. A comprehensive review of ozone monitoring, meteorological and emissions data by the Ozone Transport Commission (OTC)[2] has concluded that during these episodes, ozone and ozone precursors are circulated and recirculated over the entire OTR, including states to the south and west of the OTR boundaries. Due to nocturnal transport above the surface boundary layer, emissions of ozone precursors (including NO_x) from every section of the OTR can potentially contribute to exceedances of the health standards in nearly every part of the region.[2] Data from the EPA Interim Emissions Inventory (to be used in State's November, 1994 SIP submittals) shows that roughly 2/3 of the entire OTR's NO_x emissions are released by sources in three states: Pennsylvania, New York, and New Jersey.[2]

Two well studied ozone episodes, July 7-9 1988 and May 22-24, 1992, are used in the OTC report[2] to illustrate these conclusions. During the July 1988 episodes, transport of ozone occurred from areas south and west of the coastal urban corridor. Early morning (sunrise) ozone levels of 60 to 120 ppb (50% to 100% of the federal health standard) were measured on three successive days along the western edge of the OTR from Virginia north to New York. Wind trajectories brought these polluted air masses over the coastal corridor where ozone generated from local emissions added to already high baseline levels to produce substantial exceedances of the health standards. The May, 1992 episode also illustrates how ozone and precursors from one day are recirculated through the OTR at night to produce high sunrise ozone concentrations at rural, northern sites. Air trajectories looped from the mid-Atlantic coast up through western sections of the OTR and back to northern New England. The 1992 monitoring data and air trajectories clearly show transport of ozone and precursors occurred over the entire OTR including western areas of Virginia, Pennsylvania, and New York, and portions of the Ohio Valley.[2,3] From the study of these episodes, the OTC report concludes that major source regions that contribute to high ozone concentrations in the OTR include both rural and urban areas as far west as the Ohio Valley. These conclusions are further supported by the NESCAUM analysis of air monitoring data discussed in the next section.

Regional Oxidant Modeling (ROM) has not yet been applied to answer the specific questions of where NO_x reductions in the OTR will be most effective in reducing peak ozone concentrations. On May 19, 1994, the ROMNET Management Review Committee of the OTC decided to run ROM this summer for several scenarios that represent imposition of stringent NO_x controls in portions or all of the OTR.[4] The results of those simulations may add additional information.

Based on the evidence available today, it appears that <u>all</u> NO_x source areas in the OTR may in certain instances contribute to high measured ozone concentrations during ozone episodes, including areas outside of the urban coastal core which are either ozone attainment or one of the lower nonattainment classifications. Major NO_x sources in western portions of OTR contribute ozone precursors that are transported throughout the region by the recirculation motions of high pressure cells.

3.0 ALLOWANCE TRADING WITHIN A Budget REGION

The trading of allowances within a budget region will work most effectively to lower overall NO_x compliance costs when there are as few restrictions on trading as possible. As discussed in the next section, there are statutory limitations on the direction of some emission trades performed to satisfy the emission offset requirements of New Source Review for a new or modified facility. This section addresses trading of NO_x allowances under a regional budget between existing sources, and such trading is <u>not</u> restricted by Section 173 of the Clean Air Act. The question addressed is whether there is any scientific justification for limiting the direction of trades.

An analysis of air monitoring data during three ozone episodes in 1992 was performed recently by the NESCAUM Committees on Data Management and Ambient Monitoring and Assessment:[3] May 21-23; June 12-14; and August 22-27. The directionality of pollutant flow and air mass histories were analyzed using the Monte Carlo Regional Model, which was developed at the Center for Air Pollution Impact and Trend Analysis (CAPITA). The analysis used three dimensional meteorological data to trace backwards over four days the paths taken by air masses arriving at various monitoring sites. In addition to the generally presumed southwest winds during ozone episodes, evidence was found of air and pollutant movement in every compass direction.

Enhanced southwest flow was found when the ozone-producing high pressure system stagnates, and

> "... the resultant southwesterly flows around the backside of the high can initially enhance transport from the Midwest to the Northeast, and later (as the high moves further East) produce flows which align directly along the East Coast urban corridor, enhancing ozone accumulation along and to the Northeast of the corridor."[3]

In addition to the southwest flow, each episode showed other air flow directions. NESCAUM's analysis found that all three 1992 episodes were associated with a "regression" of a strong high pressure system from northeast towards the southwest. This resulted in the two-way exchange of air throughout the region. For example, the May 1992 episode appeared to circulate polluted air over virtually the entire OTR, and

> "... the ambient concentrations and airmass histories during this episode provide a number of relatively clear cut examples of transported emissions from sources in the North, South, East and West of the OTC region contributing to elevated concentrations and multiple exceedances throughout the region."[3]

The August, 1992 episode clearly shows air trajectories that begin over upstate New York, cross the whole of New England, curve south and east over the Atlantic Ocean and arrive in New Jersey where ozone exceedances were measured. During the same period, air trajectories closer to the center and on the back side of the high pressure cell moved ozone and precursors from the mid-Atlantic area and northern New Jersey back into western New England. Thus New England was both upwind and downwind of the New Jersey/mid-Atlantic area during the same ozone episode.

Based on the available evidence, there is no need or justification to limit the direction of allowance trading within a budget region. While transport of pollutants from southwest to northeast along the urban coastal corridor normally occurs during an episode, transport in the opposite direction and in fact in all directions occurs between sections of the OTR during episodes. The lack of any directional limits on allowance trading is consistent with EPA policy for emissions trading where statutory requirements are not imposed. For example, on the trading of offsets between various attainment portions of the OTR, EPA has stated that "our policy preference is to permit the States to allow ... trading ... without further limitations."[5]

4.0 CAA SECTION 173 RESTRICTIONS

There are two types of regional emissions trading: that which is done to provide a source with emission offsets under New Source Review (NSR) and trading unrelated to emission offsets (non-NSR). The distinction is important because some NSR offset trading is subject to restrictions given in Section 173(c)(1) of the Clean Air Act. Under a NO_x budget program, it is envisioned that NO_x allowances will be traded within a budget region to provide the means for lowering compliance costs. Allowance trading may be between existing sources for this economic purpose or it may be between an existing and a new or modified source. In the latter case, the use of allowances in the NO_x budget program to satisfy an emission offset requirement will be subject to the restrictions in Section 173, as formalized in recently issued EPA policies.[5,6]

Offset trading can be broken down into five categories:

1. **Trading from one attainment area to another.** EPA's policy preference is to permit the States to allow offsets trading within attainment areas without further limitations.

2. **Trading from an attainment area to a nonattainment area.** Not allowed. John Seitz writes "we [the EPA] do not think emissions reductions in an attainment area can offset new growth in a designated nonattainment areas."[5]

3. **Trading from a nonattainment area to an attainment area.** Any attainment area can obtain emissions offsets from any nonattainment area in the OTR without further limitations.

4. **Trading within the same nonattainment area.** No special trading conditions apply when the source reducing emissions is in the same nonattainment area as the new or modified source.

5. **Trading between non-attainment areas.** Two criteria apply. First, the area in which the credits or allowances originate must have the same or a higher nonattainment classification as the area where the new or modified source is locating. Second, emissions from the originating area must "contribute to a violation of the national ambient air quality standards" in the area where the new or modified source is locating.[5] EPA has established the test for the second criterion as the originating area being within two days transport or 200 km "upwind of the new source location".

   It is the responsibility of source subject to NSR to convince EPA what "2 days transport time" represents and what constitutes an "upwind area". In light of the discussion in chapter 3, it may be possible to convince EPA that almost any area can be considered upwind during certain episodes. In a recent study of meteorological conditions associated with high ozone days, researchers found that the median distance traveled in the 24-hours before an ozone exceedance was about 500 km for cities in the Northeast.[7] Thus it could be argued that 2 days transport time is 1000 km.

It can be seen that Section 173 restrictions only apply to a portion of the possible trades that might be performed for emission offsets. EPA's policy provides an incentive for new major sources or major modifications to locate within the attainment portions of the OTR (or outside the OTR entirely) and under those circumstances no restrictions on trading apply.

The Section 173 restrictions do not affect the core of the NO_x budget program, as NO_x allowance trading under the budget is an activity unrelated to NSR. It is possible that some affected sources may want to also trade their NO_x allowances to new or modified major sources needing emission offsets. In some portion of those trades, the restrictions of Section 173 will apply. It should be explicitly stated in the NO_x budget design that the trading program is not directly related to NSR, and that trading of allowances between existing sources should be as free as possible within the budget region.

EPA has stated that free trading of allowances within a NO_x budget region is acceptable to the Agency so long as EPA receives a technical demonstration that the redistribution of emissions within the budget region will have no adverse affect on ozone attainment.[8] NESCAUM has submitted data to EPA to address that concern and if rejected, the NO_x budget program will need to include a demonstration in the reconciliation portion of the Economic Incentive Program (EIP) used to implement the NO_x budget.

5.0 SUMMARY

Based on the available evidence, it appears that all NO_x source areas in the OTR may in certain instances contribute to high measured ozone concentrations during episodes, including areas outside of the urban coastal core and areas along the western boundaries of the OTR. While transport of pollutants from southwest to northwest along the coast is normally observed during an episode, transport in the opposite direction and in fact in all directions occurs between sections of the OTR over multi-day episodes. From these data the following conclusions are drawn:

- The NO_x budget region should encompass the entire OTR in some form.
- There is no need or justification to limit the direction of allowance trading within a budget region.

The Section 173 restrictions on emissions offset trading do not affect allowance trading between sources subject to a NO_x budget program since NO_x budget is unrelated to NSR. It is possible that some sources holding allowances may want to trade those allowances to new or modified major sources needing offsets. In a portion of those trades, the restrictions of Section 173 will apply.

J883R2

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FEASIBILITY OF A REGIONAL NO_x BUDGET SYSTEM

POWER POOLS

Issue Paper #3

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1.0 INTRODUCTION

A majority of the stationary source NO_x emissions in the Ozone Transport Region (OTR) are emitted by electric utility and non-utility power generating facilities. The nature of electricity use in the region is such that power generating units operate at or near capacity (and therefore have their maximum NO_x emissions) on the hot days when ozone episodes occur, whereas other industrial emissions of NO_x are not correlated with ozone days. Since power pools exert a high degree of control over the operation of these facilities, it is important to understand how the power pools might assist the states in a NO_x budget program. Specific objectives of this paper are to explore the feasibility of: (1) using the pool areas as the defined regions in which a NO_x budget applies, and (2) using the pools themselves as administrators of the NO_x budget program.

A power pool is two or more electrical generating systems operated as an interconnected system to supply load requirements in a reliable and economical manner. Three power pools cover most of the OTR: the PJM system (the Pennsylvania-New Jersey-Maryland Interconnection operating in New Jersey, Maryland, Delaware, District of Columbia and portions of Pennsylvania and Virginia); NYPP (the New York Power Pool); and NEPOOL (the New England Power Pool covering all six New England States except northern Maine). Information was gathered through discussions with pool representatives and in the case of NYPP during a day long visit to the NYPP operations center outside Albany, NY. While other power pools west and south of PJM could have been surveyed, the data collection performed was adequate to answer the objectives stated above.

2.0 NY POWER POOL

NYPP ("nip") is a voluntary association of eight member companies covering all of New York (see Figure 1). NYPP was established to ensure system-wide reliability and prevent large-scale outages. Its secondary mission is to reduce electricity costs through "security-constrained, least-cost dispatch". To ensure reliability, the dispatch software at NYPP will automatically override the least cost ordering. NYPP also: coordinates generator maintenance schedules; provides the energy billing system for transfers of power between its member companies; and acts as a broker in buying/selling power for its members outside New York State. The other two power pools (PJM, NEPOOL) were established for the same reasons and provide similar services to their member companies.

Given the location of load centers in the east and significant generation in the west, NYPP is generally concerned with moving power from west to east in New York. Thus, some of the power consumed in downstate New York is always being generated in western, upstate New York, especially during summer peak demand periods. All of the plants NYPP dispatches are in New York except for Homer City in Pennsylvania which is owned in part by a New York utility. NYPP does not however control the operation of all power generating units in the power pool. First, it does not control a large portion of the non-utility generators (NUG's) which at present constitute 3,000 MW of capacity and as a group will grow to 5,500 MW by 1995. NYPP must however "dispatch around" many of the NUG's. These NUG's are classified as non-dispatchable and the New York utilities must buy their power even if lower cost power is available from utility-owned units when the NUG's are available. NYPP has to then account for the power generated by the NUG's and reduce member company power units to compensate.

At the time NYPP was visited (mid-day on a Tuesday in the spring) the NUG's were supplying 15% of the pool's power, hydro was supplying 30%, and nuclear 14%. Only 41% of the power being used in New York was being generated by fossil fuel units under the control of NYPP. Pools have only a limited amount of control over the actual operation of NO_x emitting sources in the system. A table of actual (1993) and projected (2013) energy by fuel/generation type in NYPP is given in Table 1.

NYPP also does not fully control the operation of member company fossil fuel units. It is up to each company to decide if it will put a particular unit into the dispatch order under NYPP's control. For various reasons, e.g., to ensure stability of the transmission systems, the utility companies maintain control over the dispatch of certain units, and when those are operating NYPP must adjust for them like it does for the NUG's.

During light load conditions (e.g., nighttime in the non-summer months), NYPP has difficulty getting its pool generation down low enough since NUG generation is relatively constant and the pool wants to keep all base load units on line and not actually shutdown units that will have to be used eight hours later to satisfy daytime demand. Thus NYPP will often generate more power than it needs during light load conditions and will "dump" the energy to other pools outside New York at a loss.

The dispatch algorithm for NYPP is based on the replacement cost of fuel (same approach is used in NEPOOL and a similar economic dispatch approach is used in PJM). This cost is based on daily spot market costs of the fuels, and for coal and oil the cost of storage, handling, and ash disposal is also a part of the cost. In recent years, during the summer, the spot market cost of coal, oil and gas has been fairly close, although coal has often been the cheapest fossil fuel. Hydro has zero fuel cost, and nuclear units have very low fuel costs and were not designed to cycle up and down with loads, so those two resources are dispatched first along with the NUG's (which are mostly gas fired). As demand increases the coal units in upstate New York will be dispatched, followed by the oil and gas utility units. Finally during peak load periods which typically occur on hot summer days, the combustion turbine peaking units, many of which are located in the NYC area and on Long Island, are dispatched as the last units in the dispatch order.

The NYPP "nerve center" has real-time monitoring of power plant operations and energy flows over a very wide area stretching from Michigan/Indiana on the west to New England on the east, from PJM on the south up to Ontario on the north. Although NYPP only dispatches units within New York it must be prepared to respond to sudden outages or changes anywhere in eastern North America. Real-time viewing screens show: the dispatch schedule NYPP had for that day for its eight member companies; the actual power each member was generating and the requested real-time changes (+ or -) to generation NYPP was requesting of each member company's computer center. This interactive system automatically balances the output from each generator with system loads and available must-run resources. As stated previously, NYPP (or any pool) does not have full control over the operation of all of the units in its pool. The utility companies have final control over the operation of their units. The analogy given was the pool is a conductor in front of an orchestra. The utility companies don't need the NYPP conductor to control the operation of their generating units, but the operation of their integrated systems is more efficient and better coordinated with NYPP.

NYPP maintains a "spinning reserve" of power that can be accessed very quickly equal to about 1.5 times the capacity of the largest unit operating to maintain the integrity of the system should the unit go out unexpectedly. This is done by running most operating units below their maximum capability and being able to command on a real-time basis those units to increase their output.

NYPP indicated that data on each unit's variable cost and the actual dispatch order on a typical hot summer day were confidential and not even made available to individual member companies. NYPP did indicate that on a peak demand (hot summer) day, essentially every unit in the system is running. The member companies are already competitors in some ways and that is why NYPP keeps some data confidential.

NYPP has not yet decided how to handle SO_2 allowances (Title IV) in its dispatch system. In fact, the operations staff were holding meetings on this very subject the day we visited NYPP. (NEPOOL has already decided to use "adders" which are cost factors representing the value of an SO_2 allowance in modifying the "replacement fuel cost" for each unit.) Such an approach internalizes the cost of controlling SO_2 and will lead to a dispatch system that is closer to lowest-SO_2 dispatch as well as being least-cost. NYPP operations said that they will either use adders or directly constrain dispatch to limit statewide utility SO_2 emissions. If an adder approach is used, each company will on its own decide how to price the SO_2 allowances a unit will require. The pool will not become involved in either the supply or trading of SO_2 allowances.

An impediment to power pools administering the NO_x budget program is that their roles are likely to change dramatically as the electricity market becomes more competitive. Due to the unbundling of power generation and transmission for wholesale customers brought about in part by the Energy Policy Act of 1992, electric utilities are just now facing the new world of deregulation and competition that the natural gas and telecommunication industries have been through in the past decade. For example, it is likely in the future that the eight member companies of NYPP will become true competitors and this will significantly reduce the willingness of these companies to share information and cooperate in planning and administrative activities through entities such as NYPP. In the past, company's services were directed primarily at their retail and wholesale customers and they looked to the pool to minimize their costs. In the future, companies will have to fully consider the opportunities presented by: interchange sales, sales/purchases of pollution allowances, and the threats posed by wholesale and retail competition.

There do not appear to be any benefits for either a NO_x Budget system or the regulated sources in choosing a pool as the basic area. The pools are not directly administering any of the SO_2 allowance and trading system; the responsibilities for acid rain control lie solely with the member companies. The companies are responsible for ensuring they will have adequate SO_2 allowances to cover the operation of their units implied by the planned dispatch. The same approach will be taken by the pools for any regional NO_x budget system. The pools may enter the NO_x constraints into their dispatch system, but actual recordkeeping of the use and trading of allowances would not be handled by the pools since they do not legally control the operation of power generating units, and they are not even certain what administrative roles they will be serving in 5-10 years due to the uncertainty surrounding deregulation.

If only a portion of a power pool's sources were in a budget region, or the pool's sources were in two different budget regions, this would not pose any operational problems for the pool or its member companies. In such a case, adders would account for the different constraints in the dispatch order. An example of where this already has occurred is in NYC where most power units are required to burn very low sulfur fuels. The added cost of these clean fuels is reflected in those units' adders, and NYPP considers the environmental constraints in dispatching units.

Many utilities are using NO_x averaging for RACT I compliance. It is the member companies, not the pools, who will be responsible for tracking the averaging and proving compliance to DEC. Since companies will be true competitors in the future, neither the pool nor the companies want the pool in some overall management or enforcement role regarding pollution controls.

3.0 PJM POWER POOL

The PJM power pool (see Figure 2) faces many of the same problems as NYPP in planning dispatch of its member units. NUG's are not under its direct control, and PJM often must dispatch around them, i.e., those NUG's that are not subject to utility dispatch and want to run are always allowed to. During off peak conditions, PJM has to back down some baseload plants to ensure NUG's keep running. An emission data base of PJM dispatched units has been assembled by Tech Environmental for another project from EPRI's Electric Generation Expansion Analysis System (EGEAS) and other published industry sources. These data represent projected mid-summer operations in the pool in 2003, assume RACT Phase I controls for NO_x, and will be used as supplemental data for the emissions inventory task on this project. As a result of working on the data base, confidential information has been used on PJM's dispatch order. While those data cannot be reproduced here, they show the same type of ordering discussed for NYPP. NUG's are at the top of the list (mostly fired by natural gas), followed by nuclear units, hydro units, and the large coal-fired baseload units in the system. Intermediate in the order are a mixture of oil, gas and pumped-storage units, and last to be dispatched are peaking utility gas turbine units.

PJM uses economic dispatch similar to the other two pools, and member utilities can remove units from their normal dispatch position if operating constraints dictate doing so. PJM has decided to handle SO_2 allowances with cost "adders" like NEPOOL and would likely handle NO_x allowances in a similar manner. The effects of the Energy Policy Act are already apparent in increased competition between PJM's member companies. With competition crossing pool boundaries in fact, the power pools in five years may be substantially different from those of today, with more inter-pool power sales taking place. Even today, a lot of power generated outside the OTR is imported to PA and NJ for use.

4.0 NEW ENGLAND POWER POOL

The New England Power Pool (NEPOOL) is an organization consisting of New England electric systems which have pooled their resources to produce and transmit the electricity requirements of the New England area as a single system (see Figure 3). These electric systems, called "Participants", have authorized The New England Power Exchange (NEPEX - the operating arm of NEPOOL) to dispatch their generating units through a single system approach in the most economical way possible without compromising prescribed levels of reliability. A communication network between NEPEX in Holyoke, Mass. and four satellite dispatch organizations distributed throughout the region allows NEPEX to provide dispatch direction and load control. NEPEX began operations as the master control center for NEPOOL (under the Interim NEPEX Power Exchange Agreement) on June 1, 1970.

NEPEX dispatches the Participant generating facilities to meet pool-wide demand in the optimum manner. Ownership considerations do not enter into the decision to utilize a particular unit. Units are scheduled and dispatched primarily on marginal cost principles. The transmission ties between Participants' systems are free-flowing - no effort is made to schedule transmission flow within New England. This, with central dispatch, results in continuous energy and operating reserve interchange transactions between the Participants and NEPOOL. As this continuous dispatching and energy flow occurs, no scheduled transactions are occurring within NEPOOL. In real time no Participant needs to be aware of the amount or cost of energy transactions with NEPOOL. It is after the fact that individual interchanges and their costs are determined.

The New England Power Planning (NEPLAN) group in the pool performs planning efforts concerning load forecasting, power supply environmental regulations, and demand side management (DSM). NEPOOL's sources of energy in 1993 were as follows:

Nuclear	41%
Coal	16%
Oil	16%
Gas	13%
Hydro	5%
Imports	5%
Wood/Refuse	4%

Information on the dispatch order was requested from NEPOOL but we were told that specific data are confidential and unavailable. The planned dispatch order changes from day to day, depending on many factors. In the summer, NEPOOL was able to give the following general dispatch order:

1. Prescheduled NUG's* (typically natural gas)
2. Prescheduled Hydro
3. Nuclear
4. Coal
5. High-sulfur oil
6. Low-sulfur oil
7. Combustion turbines

Natural gas fired units can appear almost anywhere in the above dispatch order, depending on the daily price of gas and the terms of their gas supply and transportation contracts. Some NUG's are out of NEPOOL's control and always run (prescheduled), while other NUG's (the newer ones) are actually dispatched by NEPOOL.

In the NEPOOL system, utility companies hand over complete control of their generating units to central pool dispatch, the only exception being emergency situations (unit breakdown). This is different from the way dispatch works in the other two pools. In NYPP and PJM, the pool dispatch tells each company on a real time basis how much to increase or decrease power generation, but the utility company itself then decides how to translate those goals into specific changes at individual units. By contrast, in NEPOOL the central dispatch directly controls each generating unit. Even

*NUG's that are not subject to economic dispatch.

in NEPOOL, however, not all electrical generating units are under central control since some NUG's operate independently.

NEPOOL provided a copy of the report, "Treatment of Sulfur Dioxide Allowances for NEPOOL Operations and Billing Purposes" (prepared by the Sulfur Dioxide Allowances Task Force, December 1992), which describes how NEPOOL will be modifying its dispatch to account for the costs of the acid rain program, and it discusses the issue of how involved the power pool should become in the trading of SO_2 allowances. NEPOOL has decided that the individual utility companies must be fully responsible for dealing with the SO_2 allowances and the pool will play no direct role. SO_2 allowances will be handled through a replacement fuel price "adder" that will be added onto the current dispatch cost for each unit in the pool. This extends the fuel price concept NEPOOL currently uses for dispatch into the environmental area and will make the fuel dispatch order a mixture of lowest-cost and lowest-emissions dispatch.

The recommendations of the Sulfur Dioxide Allowances Task Force, which are due to be implemented in 1995, are as follows:

- A Participant determined replacement fuel price adder is to be established to reflect the market value of SO_2 allowances. The adder is to be used in both operation and energy billing. By combining the SO_2 allowances adder with fuel cost and by taking in account unit efficiency, the actual optimized dispatch will minimize NEPOOL's total cost of both fuel and SO_2 allowances. Through energy billing, the Participants generating above their own needs will be reimbursed for the cost of allowances consumed. By the same energy billing mechanism, the funds for reimbursement will be provided by those Participants generating less than their own needs.

- The adder is to reflect each Participant's strategy for procuring or selling SO_2 allowances. The allowances procurement strategy is to be defined by a formula which can be consistently applied to determine the Participant's actual value of SO_2 allowances. This formula will be developed by the Participant from one or more verifiable national SO_2 allowances indices. If the Participant's actual value of allowances as determined above is less than the highest of the verifiable national allowances indices, the Participant will be permitted to use the actual value to derive the adder. If, however, the participants actual value of allowances is more than the highest of the verifiable national allowances indices, the Participant will only be allowed to use the highest of the verifiable national allowances indices to derive the adder. The method of determining the adder may be changed prospectively if the actual strategy for sale or procurement of allowances changes.

- The generating unit owner is to be responsible for obtaining the SO_2 allowances needed to cover the actual generation of its units. No provision will be made for NEPOOL to facilitate the exchange of allowances between Participants. If a Participant needs allowances beyond those allocated to it by the EPA, the Participant must either reduce its emission of SO_2 or obtain additional allowances.

5.0 SUMMARY

The power pools direct the operation of generating units less than we initially thought. Most NUG's and even some utility units are outside of the dispatch rules. In addition, dispatch is a highly interactive process where the units actually run can vary from those scheduled and the dispatch order can change daily, just due to changes in spot market prices of fuels. Planning how to satisfy a NO_x budget would not be made easier by trying to administer such a budget through the power pools.

In two of the three power pools (NEPOOL being the exception), the pool lacks the complete, legal control of individual units needed for enforcement. Deregulation of the electric power industry in the next few years will further decentralize authority, the pools themselves will change, and the pools may only be effective organizations for ensuring reliability in the future. Thus, the NO_x budget program should not be built around power pools as a geographic or administrative unit.

The pools are currently dealing with how to handle SO_2 allowances under the acid rain program in their dispatch systems. NEPOOL and PJM have already adopted a policy of using cost "adders" that will move the dispatch order closer to one that is a low-emissions dispatch. NYPP is still studying options. The pools and their member companies will have sufficient experience with SO_2 allowances to be able to deal with NO_x allowances and a NO_x budget program in a similar way.

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FIGURE 1

NYPP

NEW YORK POWER POOL

CENTRAL HUDSON GAS & ELECTRIC CORPORATION
CONSOLIDATED EDISON CO. OF NEW YORK, INC.
LONG ISLAND LIGHTING COMPANY
NEW YORK STATE ELECTRIC & GAS CORPORATION
NIAGARA MOHAWK POWER CORPORATION
ORANGE AND ROCKLAND UTILITIES, INC.
NEW YORK POWER AUTHORITY
ROCHESTER GAS AND ELECTRIC CORPORATION

Coordinated by NYPP Planning Staff

1993

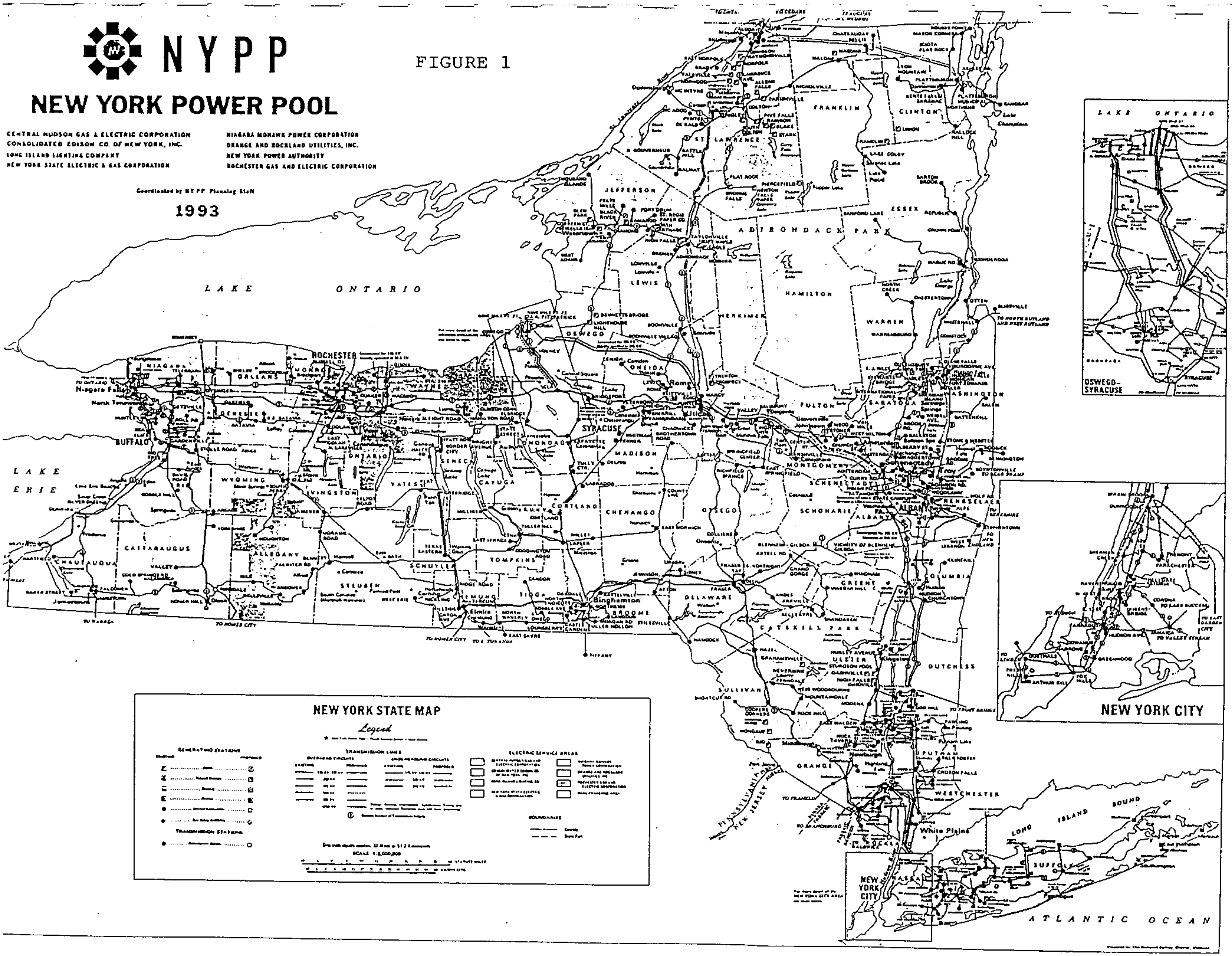


TABLE 1

NYPP GENERATING CAPACITY AND ENERGY MIX

CAPACITY			ENERGY	
1993 (Actual)	2012		1993 (Actual)	2012
14%	15%	HYDRO(1)	19%	15%
46%	45%	OIL	9%	10%
1%	2%	GAS	11%	9%
13%	12%	COAL	18%	15%
14%	10%	NUCLEAR	18%	15%
3%	3%	PURCHASES	12%	9%
9%	13%	NON UTILITY GENERATORS	13%	27%
100%	100%		100%	100%
35,668 MW(2)	36,314 MW(2)		147 BILLION KWh(3)	172 BILLION KWh(4)

FORMAT/FUEL.MIX
01.21.94

(1) Includes Pumped Storage

(2) Prior to Sale of Capacity

(3) NY State Load only (does not include pumped storage load or energy generated for sales. Total energy production was 153,021 GWh.)

(4) Total Energy Production (includes Sales and Hydro Adjustments)

FIGURE 2

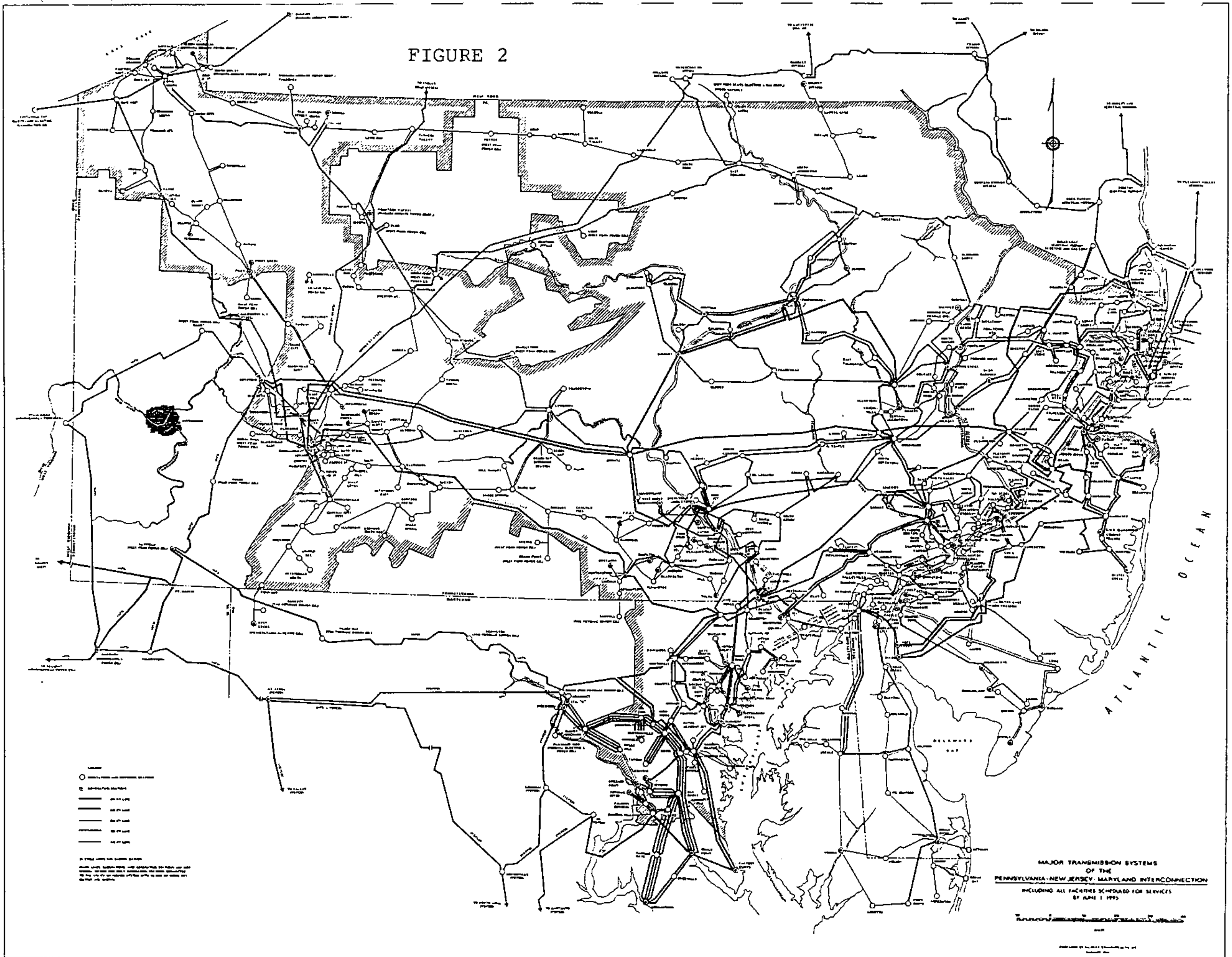
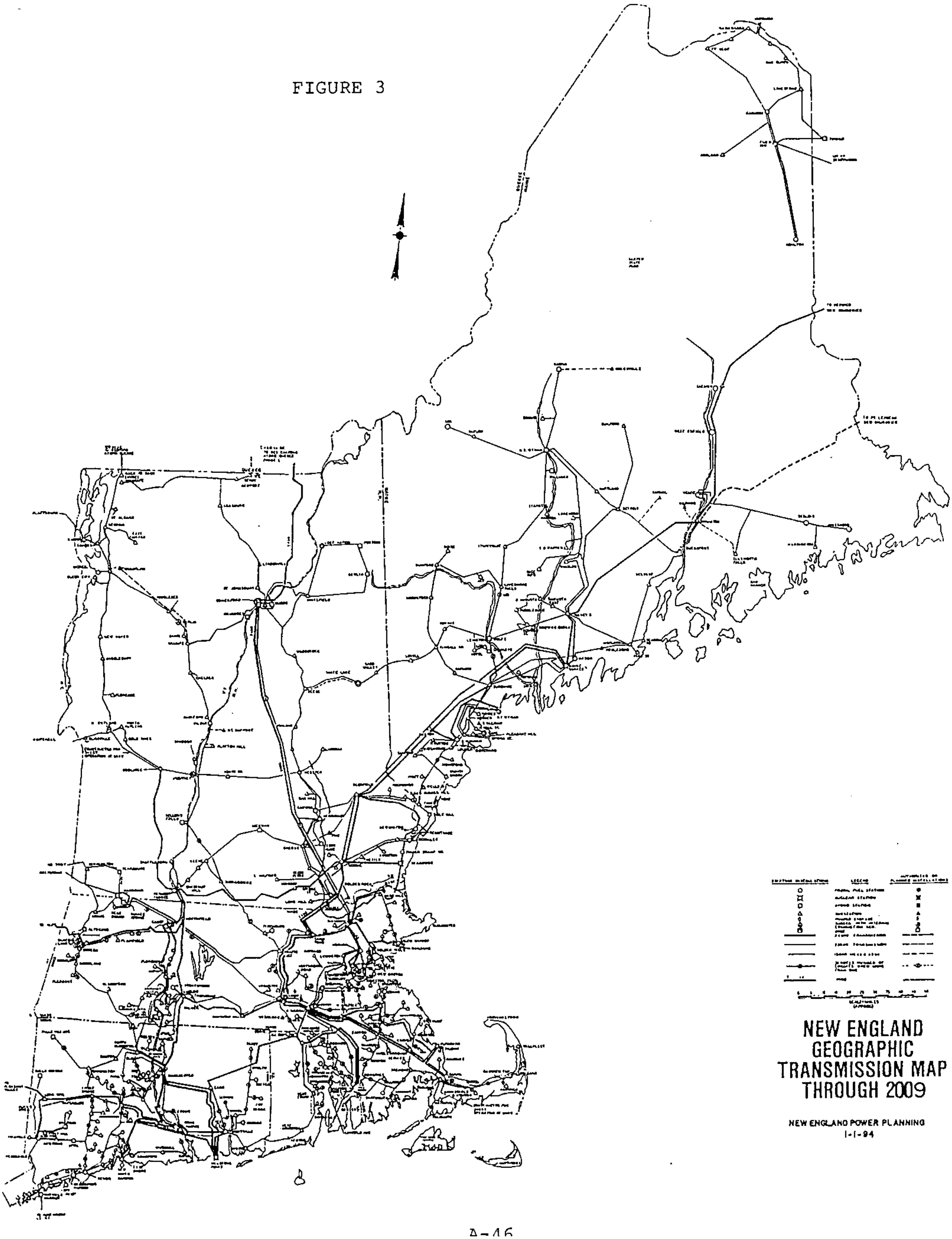

MAJOR TRANSMISSION SYSTEMS
OF THE
PENNSYLVANIA-NEW JERSEY-MARYLAND INTERCONNECTION
INCLUDING ALL FACILITIES SCHEDULED FOR SERVICES
ATLANTIC OCEAN

FIGURE 3



NEW ENGLAND
GEOGRAPHIC
TRANSMISSION MAP
THROUGH 2009
NEW ENGLAND POWER PLANNING
1-1-94

FEASIBILITY OF A REGIONAL NO_x Budget SYSTEM

ESTABLISHING A BASELINE

Issue Paper #4

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Version 4

1.0 INTRODUCTION

A critical element of the design of a regional NO_x Budget system is the "baseline" that will be used to allocate emission allowances to the facilities targeted by the budget. The purpose of this issue paper is to evaluate the different elements of a NO_x budget baseline and to offer recommendations for the design of the baseline that can be incorporated in the Options Development Paper.

In evaluating each of the elements of the NO_x budget baseline, three objectives will be weighed: (1) economic efficiency, i.e., whether the alternative promotes the objective of minimizing the costs of achieving the NO_x emission reductions necessary to achieve the ozone NAAQS;[1] (2) equity, i.e., the degree to which the alternative ensures an equitable sharing of the cost of reducing NO_x emissions based on each facility's relative NO_x emissions and contribution to exceedences of the ozone NAAQS; and (3) administrative ease, i.e., the relative difficulty of implementing the alternative. As with the design of any program, each of these objectives must be carefully balanced if the NO_x budget is to be effective. However, for different elements of the baseline different objectives should be given greater consideration. The two major aspects to the development of the NO_x budget baseline are: (1) the time of year that the budget will be in place; and (2) how the NO_x allowances will be allocated to the facilities targeted by the budget. The most important objective when determining the time of year that the NO_x emissions will be in place is cost-effectiveness; whereas the most important objective when evaluating how the NO_x allowances will be allocated is equity. In addition to balancing these objectives, the design of the baseline must also consider the degree to which the different elements of the baseline are interrelated.

2.0 PROGRAM PARAMETERS

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[1]Because the objective of the NO_x cap is to assist with the attainment of the ozone NAAQS, an alternative's cost-effectiveness should be evaluated in terms of the relative cost of achieving a specific reduction in ambient ozone levels, i.e., $\$/O_3$ ppm.

While a baseline for an emissions budget can take many different shapes and a number of different elements must be considered in its development, three different elements of the baseline will be evaluated in this issue paper: (1) the control period during which NO_x emissions will be subject to the budget program; (2) the baseline emissions which define the method by which allowances will be proportionally allocated; and (3) the baseline emission adjustments which identify any adjustments to the baseline allocation that will be allowed when implementing the budget.

2.1 Control Period

There are three practical options for defining the control period during which NO_x emissions will be subject to the budget: (1) an annual budget; (2) a seasonal budget; and (3) a combined annual and seasonal budget. Because the primary objective of the NO_x budget system is to reduce NO_x to aid in the attainment of the ozone NAAQS, the summer ozone season is the most appropriate control period over which a facility's NO_x emissions should be evaluated. A summer ozone season control period will ensure that the NO_x emissions are reduced at the appropriate time of year and allow intermittent control strategies which are most cost-effective during the summer months, such as fuel switching, which would not be practical for complying with an annual budget. Therefore, defining the control period in terms of the summer ozone season expands the number of feasible control techniques and ensures that the control techniques are effective in reducing NO_x emissions during the summer ozone season. For example, if two control techniques produced equivalent reductions in NO_x emissions and had the same total costs, but one technique reduced NO_x emissions at a constant level throughout the year, while the other just reduced NO_x emissions during the summer season, then clearly the technique that provided emission reductions during the summer period should be viewed as the more cost-effective since it would likely yield the greater reduction in ambient ozone levels. By extension, if the objective is ozone attainment, then non-summer period NO_x reductions are ineffective and, as a consequence, should not be the prime consideration.

If the objective of the NO_x budget program were to reduce nitrate deposition levels, then it might be appropriate to give some consideration to annual NO_x emission levels in the formulation of the budget.[2] For example, a hybrid budget could be established that would consider the facility's seasonal and annual emission reductions. However, adding a second element to the budget's control period will potentially reduce the cost-effectiveness of the budget as an ozone NAAQS attainment strategy. Furthermore, a seasonal budget will automatically yield reductions in annual nitrate deposition levels since NO_x RACT controls NO_x emissions during the months outside the ozone season. Finally, having both a seasonal and an annual budget will increase the difficulty of administering the budget. In summary, the preferred control period alternative for attaining ozone standards is a seasonal control period that is consistent with the ozone season.

[2]There are no regulatory standards that specify an acceptable level of nitrate deposition.

2.2 Baseline Emissions

Baseline emissions define the method by which NO_x allowances will be allocated to sources each year. Three choices should be considered when establishing the baseline for the NO_x budget: (1) the combustion unit's power output (MW or lb/hr steam); (2) the combustion unit's heat input (MMBtu/hr); or (3) actual NO_x emissions.[3] Allocating NO_x allowances on the basis of the facility's power output over the baseline period appropriately rewards efficient units and penalizes inefficient units since NO_x emissions would be allocated on the basis of the facility's energy output, not input. However, implementing the first alternative could be complicated by the fact that the measure of energy output varies among generators, boilers, engines and other sources. The second alternative, on the other hand, is likely to be easier to implement since allocating allowances on the basis of the energy input provides a common measure for all fuel combustion facilities. While the second alternative does not directly consider the relative efficiency of the unit, the use of mass emission limits instead of emission rates does encourage energy efficiency.

The third alternative would result in emissions reductions being made on a proportional basis; therefore, facilities that had reduced their NO_x emissions more than average as a result of the NO_x RACT, would be required to make just as much of a percentage reduction as those facilities that previously reduced their NO_x emissions very little. Facilities that have not reduced their NO_x emissions at all in the past would be rewarded. This is in many ways inequitable. By allocating allowances on the basis of NO_x emissions, facilities that have already made an investment in NO_x emission controls would in fact be penalized relative to facilities

[3]Another possible alternative that is not discussed is the use of the facility's potential to emit. As discussed in Issue Paper #1, basing allocations on the potential to emit could actually result in an increase in emissions since actual emissions will be lower than the potential emissions.

that have not controlled their NO_x emissions. This type of alternative is often referred to as fuel-specific, while the first two alternatives are fuel-independent. As described in Issue Paper #1, the allocation of allowances in Phase II of Title IV of the CAAA and in SCAQMD Rule 1135 are done on a fuel-independent basis, while the allocation of allowances in the RECLAIM program is done on a fuel-specific basis. Given the inequity of allocating allowances on the basis of NO_x emissions, the third alternative should be not be considered. A decision as to which of the first two alternatives should be used should consider the tradeoffs between the difficulty of administering the budget and the equity of the alternative.

2.3 Baseline Emission Adjustments

The final consideration in the development of the baseline is whether there will be any consideration of major factors that could require adjustments to the baseline because it is not representative or produces an unintended result. For example, the baseline could be adjusted to reflect the operating histories of units to account for the fact that a unit may not have operated in a specific year. This is likely to be a significant issue for standby or moth-balled units that did not operate in the base year. While the owners of these facilities could claim that these facilities should be allocated allowances to enable the units to operate at some time in the future, giving these facilities allowances even though they did not operate in the base year (or a representative year) would be allocating allowances on the basis of potential to emit. Therefore, a facility's baseline emissions should not be adjusted if the unit is truly a moth-balled or standby unit, i.e., no allowance should be allocated. For equity, adjustments should be made in the case where 1990 is a single non-representative year of a unit's operation.

FEASIBILITY OF A REGIONAL NO_x BUDGET SYSTEM

BUDGET REGIONS AND AFFECTED SOURCES

Issue Paper #5

Prepared for:

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July 29, 1994

Version 3

1.0 INTRODUCTION

The NO_x budget is a regulatory limit on the total tons of NO_x released into the atmosphere by a defined group of stationary sources, the "affected sources", within a geographic area called the "budget region". The objectives of this paper are to address the following questions regarding the NO_x budget program:

(1) What groups of sources should be included in the budget program?

(2) How many budget regions should be used, and what geographical areas should these cover?

2.0 AFFECTED SOURCES

A substantial portion of stationary source NO_x emissions (80-90%) in the Northeast States are emitted by four source categories: utility boilers, industrial boilers, combustion turbines, and large internal combustion engines.[1] Of these four categories, utility boilers are the largest component. For this reason, any definition of affected sources should begin with utility boilers. Many options exist for defining affected sources, and Issue Paper #1 concludes that a budget program should be designed from as large a source population as possible, to widen the opportunities for NO_x allowance trading and thereby lower NO_x compliance costs. Two practical considerations however must be recognized. First, a NO_x budget system will only be effective if it can be enforced. Due to lack of permits (and therefore enforcement mechanisms) for mobile and area sources, these source types are not easily included in a NO_x budget system. For the initial budget design, they therefore should be excluded. Second, if the number of stationary sources in the budget is too large to administer, then problems could occur. Thus, some type of *de minimus* threshold on stationary source size is warranted, reflecting the difficulty of monitoring and enforcing a budget for a large number of small sources.

A large range of choices are available for the definition of affected sources, from the smallest group of important sources (utility boilers only) to the largest possible group (all stationary sources). Given the fact that several types of stationary sources can often be found at an electrical generating facility (not just boilers) and that intra-facility trading of allowances should be encouraged, a reasonable choice for the minimum definition is: all fuel combustion units (including boilers, turbines, engines) at electrical generating facilities. Non-utility generators (NUG's) are included in this choice to ensure NO_x budget does not put utility generating stations at a competitive disadvantage.

A 1990 baseline emissions inventory has been assembled for sources in the Ozone Transport Region. Included in the inventory are sources with actual emissions in 1990 of 25 tons or more of NO_x. Summary data from the project's inventory show a regional total of about 12 million lb/day on a peak ozone day of which 90.4% is emitted by electric generating facilities. Another 2.6% is emitted by the largest industrial boilers (those with heat input rates of 250 MMBtu/hr or more). These two groups together cover 93.0% of all stationary source NO_x emissions on peak ozone days and the number of sources to track is manageable. Thus, combustion units at electric generating facilities plus industrial boilers sized 250 MMBtu/hr or larger make a reasonable second choice.

Finally, it will be necessary to ensure that any NO_x budget is federally enforceable. Since all facilities defined as "major" for the purposes of Title V of the Clean Air Act will already be holding a federally enforceable permit (an operating permit), the next logical choice to consider which is more inclusive is: all fuel combustion units located at major facilities (25 to 100 tons/yr potential, depending on location).

There is a tradeoff between lowering NO_x control costs (the largest group of sources) and minimizing budget administration (the smallest group of sources). Maximizing the source group size is desired, subject to practical limits. The third choice is impractical since thousand of sources will be added into the NO_x budget program in the larger states and there will be only a small marginal benefit in terms of the total NO_x controlled given the immense administrative effort required. For this reason, the second choice is recommended.

3.0 BUDGET REGIONS

Four possible options for defining budget regions in the Ozone Transport Region (OTR)[2] are:

- State boundaries;
- Multi-state, regional areas;
- Urban Airshed Model (UAM) domains;
- Power pool areas.

Issue Paper #1 concludes that for economic reasons a budget region should be as large a geographic area as possible, thus the benefits of a NO_x budget and trading system will not be realized if budget regions are limited to state boundaries. Issue Paper #3 concludes that there are no advantages to using power pool system areas as budget regions. Issue Paper #2 recommends, on the basis of a review of ozone monitoring data, that all portions of the OTR be included in some type of budget region. Since UAM domains do not cover the entire OTR, selecting UAM domains as the basis for budget regions is not recommended either. What is recommended therefore is one or more multi-state budget regions that cover all of the OTR.

A single OTR budget would be easiest to administer and would maximize trading opportunities. A single budget would imply, however, that NO_x emissions in western portions of the OTR and along the coastal corridor have equal effects on ozone concentrations during episodes, an unproven assumption. Thus, it seems two budgets should be used, so that different limits could be set in the nonattainment areas along the coast and in the remainder of the OTR.

A related concern is that of power importation from outside of the OTR. For example, it is possible that stricter limits on NO_x in western Pennsylvania may encourage Ohio utilities just over the state line to import power into the region, but not generate it as cleanly with the NO_x emissions blowing back into the OTR. Discussions with the power pools indicate that the potential for importing substantially more power on peak ozone days is minimal due to the limited transmission line capacity and the fact that power already is imported into the OTR on peak days. In addition, the associated emissions may be lower if the out-of-region power is generated by hydro or nuclear units. Power importation, while an inescapable factor in any control program that is less than nationwide in scope, should not affect the efforts of the OTR states to control ozone.

In summary, the recommendation is for two budget regions: (1) the contiguous non-attainment area (classified marginal and above) along the coast, and (2) the remainder of the OTR. These areas are shown in the following figure.

4.0 REFERENCES

1. Amar, P., Bradley, M. and Boysen, D., "A Market-Based NO_x Emissions Cap in the NESCAUM Region," Air Pollution Control, published by Warren Gorham Lamont, March 1993, p. 9.

2. The Ozone Transport Region (OTR) is defined by: the eleven states Pennsylvania, Maryland, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, Maine; the District of Columbia; and a portion of northern Virginia. The area of Virginia that is included consists of the Counties of Arlington, Fairfax, Loudoun, Prince William, and Stafford as well as the municipalities of Alexandra, Fairfax, Falls Church, Manassas and Manassas Park (57 FR 56766, November 30, 1992).

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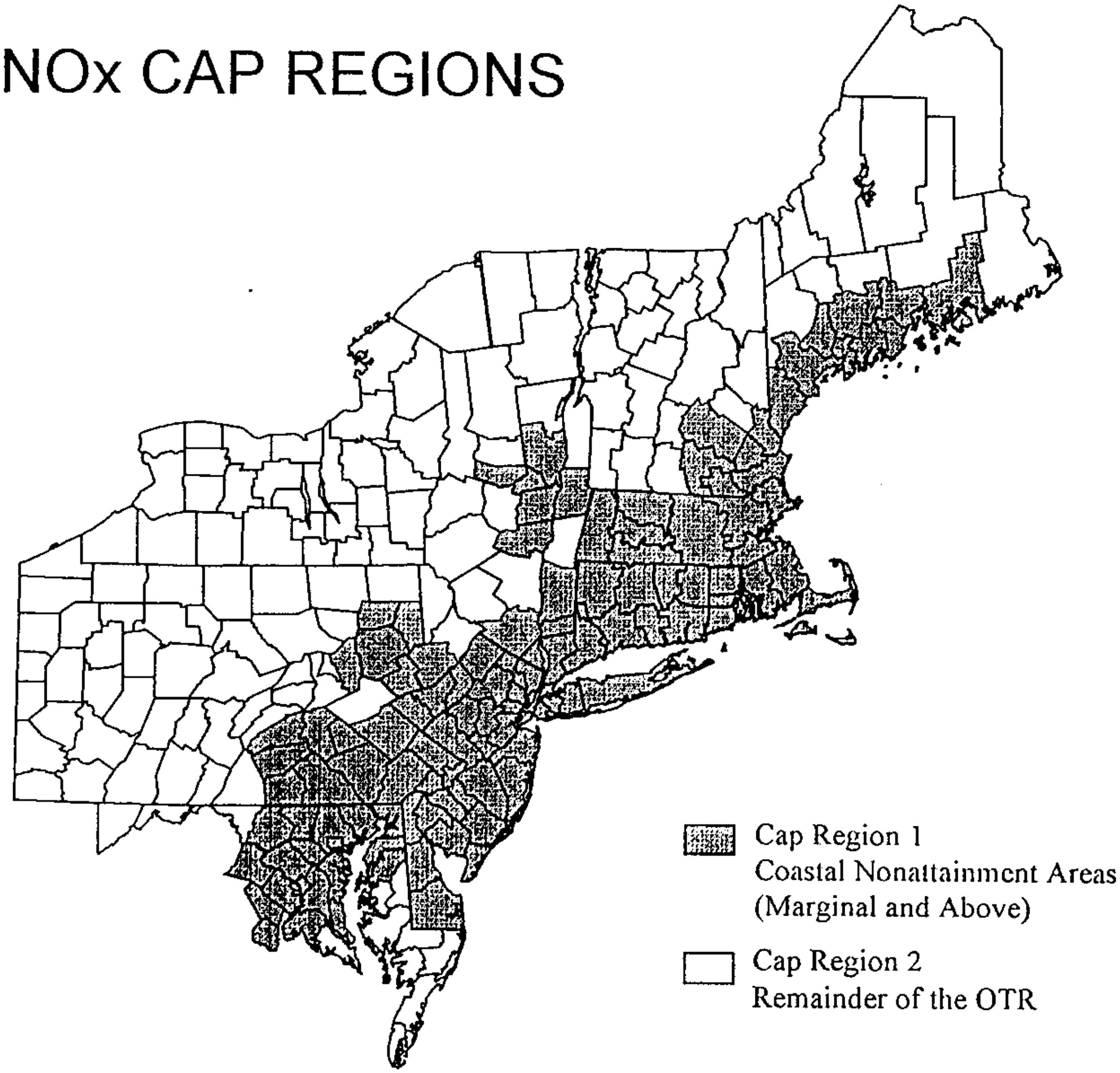
PROPOSED NOx CAP REGIONS



APPENDIX B

EMISSIONS DATA BASE SURVEY RESULTS

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STATUS REPORT
ON EMISSIONS DATA BASE TASK

May 17, 1994 Ref 883

To: Donna Boysen

From: Peter Guldberg

The objective of the emissions data base task is to assemble a consistent and comprehensive emissions inventory for all NO_x point sources with actual emissions of 25 tons/yr or more in the twelve OTR states plus D. C. The data should represent the 1990 baseline year with a correction for RACT Phase I controls. The work plan calls for this task to run from mid-April through the end of June. On April 15 a data request list was prepared for NESCAUM (copy attached) and on April 18 Praveen sent out the request to all of the states and UAM modeling leaders, with a reply date of May 2. Over a month has elapsed since then and it is time to assess what data have been received and to select a course of action.

To date, the response has been as follows:

- Replies received from: NY, VA, DE, VT, MD, CT
- No reply from: ME, NH, MA, RI, NJ, PA, DC, or any of the UAM modeling groups.

**NJ reply received June, 1994.

The responses that have been received are incomplete in terms of the information provided, and only half have provided computer disks. Some utility data were received from Sandra Chen in NJ prior to the data request being sent out. On a parallel track, we have collected information from other sources (EPA, EEI, NYPP, NEPOOL and PJM) fearing that the response to the survey would be incomplete. The information available from each source is summarized below.

New York

NY DEC provided two computer disks, a list of sources shutdown since 1990, and a copy of their RACT regulations. The computer disks contained three files, one of which was unreadable. The readable files are in a word processing text format that can not be analyzed by spreadsheet software. The files are immense and reportably cover all 25 tons sources in New York. Unfortunately, they are not usable in their current form. This is not unexpected as I had several phone calls with Syed Mehdi at DEC about the difficulties they had in trying to satisfy our request.

Virginia

VA DEP provided a disk that contained no emissions data and a printout that lists plant name, county, SCC and actual NO_x emissions for only seven facilities in the State. These data are not useful.

Delaware

DE DNR provided a fairly complete list of data for the 73 point sources at 19 facilities in their state which had 25 tons of NO_x emissions in 1990. No computer disk was provided. The printout lists: source name, county, SIC, SCC, annual operating schedule, annual fuel use and ozone season daily fuel use, capacity in MMBtu/hr, NO_x emission factor (lb/fuel use), type and quantity of primary and secondary fuels, 1990 actual NO_x emissions (annual and ozone season), and MW capacity for power generators. In addition, the DNR provided a long letter explaining each of the data fields and how to properly use them. Shutdown sources were excluded from the list.

Data not provided include: a copy of the RACT rules, list of new sources (assume none), power grid/pool information, potential emissions, and minor/major classification.

Vermont

VT ANR provided a fairly complete list of data for the 58 point sources at 14 facilities which had 25 tons of NO_x emissions in 1990. No computer disk was given. The printout lists: source name, county, attainment status, SIC, SCC, annual hours of operation, capacity in MMBtu/hr, NO_x emission factor (lb/MMBtu), primary and secondary fuel type and use, actual annual NO_x emissions and potential NO_x emissions. Vermont's RACT regulation was sent to us.

Data not provided include: operating hours by quarter and for the ozone season, MW capacity.

Maryland

MDE provided a computer disk and printout for 28 utility boilers at 11 utility stations and for 53 industrial facilities in the state with 25 tons of emissions. For the utility units, the print out lists: source name, fuel types (but not quantities), NO_x emission factor (lb/MMBtu), capacity in MW, actual annual NO_x emissions, and the unit specific RACT emission limit. Data not provided include: county, attainment status, SIC, SCC, operating hours by quarter and for the ozone season, capacity in MMBtu/hr (is actually listed but numbers are suspect), quantities of fuel, potential emissions, major/minor classification, or power grid. No shutdown list was given.

For the industrial facilities, no point source specific data were given, only facility totals for fuel use, actual annual NO_x emissions, SIC, county and source name. Most of the requested parameters were missing.

Connecticut

CT DEP supplied us a copy of a letter and printout (no disk) sent to Steve Dennis at MA DEP (presumably for ozone modeling), as well as a copy of their RACT rule. The printout is actually for two different years (1990 and 1992) and lists 99 point sources with actual NO_x emissions over 25 tons. The copy we received is hard to read in places. The data provided include: source name, county, SIC, SCC, fuel types and amounts, annual operating hours per quarter, capacity (MMBtu/hr), actual NO_x emissions and potential NO_x emissions. The data not provided are: attainment status, NO_x emission factor, capacity in MW, major/minor classification, or power pool.

New Jersey

Although NJ DEPE has not responded to the data request, Sandra sent us a fax on April 15 that appears to list all utility units in the U.S., giving the facility name, county, and state, attainment status, and total facility NO_x emissions (no labeling as to the year or actual/potential). Most of the data we requested are not provided by this utility list.

Summary of Responses

The data requests sent out in mid-April have not provided the information on which to build a data base for the NO_x cap project. Most states did not respond or sent unusable data. Some usable data were received from CT, MD, VT and DE, but even for these four states the data are incomplete.

EPA OAQPS ROM Data Files

Tech Environmental obtained a CD-ROM containing the EPA 1990 baseline point source inventory for the entire U.S. from Mr. Steve Bromberg, a consultant working for Chet Wayland at OAQPS. This CD ROM reportedly contains the files used in the 1990 ROMNET modeling. Since the data were not in a directly usable form, we purchased the PARADOX data base management software to access the information. Data for each of the 12 OTR states plus D.C. were extracted from the CD-ROM and put onto our computer hard disk. A file format for the files is attached.

The first thing you notice when looking at these files is the lack of a source name. For some reason this was not included in the modeling files. We are in the process of trying to access AIRS and download the source name data, but even if successful it may be impractical to try and add that information to these modeling files. One reason is that each data record is only uniquely identified at present by combining four data fields: state code, plant id, point id, and SCC code. On the other hand, it may not be necessary to know the name of each source for our purposes, so long as we can distinguish types of sources.

The data that appear useful on the EPA files are:

- **PLANTID, POINTID, FIPST** NAPAP plant and point id codes along with FIPS state code, the three together which provide an AIRS facility identification tag.
- **ORISID, BLRID** ORIS plant and boiler id codes which confirm whether this is or is not a utility boiler.
- **BOILCAP** Boiler design capacity in MMBtu/hr, where provided. In a few cases where this is missing it appears the data could be calculated form MAXRATE.
- **SUMTHRU** Summer throughput %. This can be used to estimate summer NO_x emissions from annual NO_x emissions.

- **THRUPUT** Operating rate, typically annual fuel consumption per year.
- **MAXRATE** Maximum design rate, typically hourly maximum fuel consumption rate. This field is often blank and would only be relied on to indirectly calculate boiler capacity when it is missing.
- **HEATCON** Fuel heat content.
- **NETDC** MW capacity for electrical generation units.
- **SCC** SCC code giving the type of combustion equipment and the type of fuel.
- **FIPSCNY** FIPS county code. Only somewhat useful since we do not have a list of the county names corresponding to each state's code. Can probably guess on county from latitude and longitude.
- **SIC** SIC code provides information on the source type.
- **EMF2** Emission factor for NO_x. This would be useful if it was filled in. It's usually blank. It can however be calculated from EMISS2, THRUPUT and HEATCON.
- **CONEFF2** Percent NO_x control efficiency in 1990.
- **EMISS2** Actual 1990 NO_x emissions (tons/year) controlled with rule effectiveness (which is 80% uniformly for NO_x).

The information not provided by the EPA CD-ROM files are:

- Source name
- Attainment status (could be estimated from county)
- NO_x emission factor (EMF2 can be calculated from other parameters)
- Potential NO_x emissions
- Major/minor classification
- Power grid/pool

<u>EPA Region I</u>

Daria Dilaj, an engineer in the Ozone Programs Section at Region I, responded to our data request by sending along computer printouts they could supply from AIRS. Data for the State of RI were sent as an example. The printouts listed: source name, county, state, SIC, SCC, annual and ozone season NO_x emissions. A field for equipment capacity (MMBtu/hr) is provided but was often blank since EPA says companies often request confidential protection on this item. Since no data on emission rate or quantity of fuel is provided, the lack of equipment capacity data in these AIRS reports makes them unusable for us.

NESCAUM NO_x Utility Boiler Report

The December 1992 report, "Evaluation and Costing of NO_x Controls for Existing Utility Boilers in the NESCAUM Region" contain data on utility boilers in the NESCAUM region. This information is not very useful since it represents 1987 conditions and only one part of the OTR.

EEI Environmental Directory

The "Environmental Directory of U.S. Power Plants, 1993" published by the Edison Electric Institute has a few items of interest, but only for utility owned, steam-electric generating stations: facility name, county, MW capacity and MW actual in the summer, and types of fuel.

NYPP Publications

The report "Load and Capacity Data 1990-2006" gives a list of utility plants and units in the New York Power Pool, the type of equipment, type of fuel and MW rating. NUG's are not listed.

The report "Load & Capacity Data 1993" gives the list of utility plants and units in NYPP as of 1992, the MW rating, and the types and amounts of fuel burned in 1992. NUG's are listed giving only their MW rating.

NEPOOL CELT Report

The "NEPOOL Forecast Report of Capacity, Energy, Loads and Transmission, 1994-2009" issued on April 1, 1994 gives a list of the utility plants and units in the New England Power Pool as of 1/1/94, their location, type of equipment, type of fuel and MW rating. The same information is listed separately for NUG's.

PJM Emissions Data

A part of a study for Mt. Hope Hydro in New Jersey, Tech Environmental has assembled an emissions inventory for the electric generation units dispatched by PJM in NJ, MD, DE, DC and portions of PA and VA. This inventory does not include units outside of the PJM power pool, including many of the NUG's. The data base includes a detailed estimation RACT Phase I emission rates for NO_x and reflects projected PJM operations in the year 2003. Data include unit capacity (MW), NO_x emission rate (lb/MMBtu), fuel type, and projected actual NO_x emissions.

RACT Limits

Most states in the OTR have established specific RACT NO_x emission limits for utility and large industrial boilers, but not all. Specific limits have not been established in MD, PA and DC.

Recommendations

The only complete emissions data for the OTR in our possession at this time are the EPA ROM modeling files, and I recommend that the NO_x cap emissions inventory be built from these files. The following steps are proposed:

(1) Eliminate sources whose 1990 actual emissions were < 25 tons.

(2) Eliminate unnecessary fields from each of the 13 state files.

(3) Sort the state files into individual county group files where a state has more than one non-attainment designation.

(4) Within each county group, sort the files into three groups: electric generation units, industrial boilers, and other.

(5) Fill in all missing emission factors by back calculating these from annual emissions.

(6) Add a column for calculated ozone season NO_x emissions (lb/day).

(7) Add two columns giving estimated 1995 annual and ozone season NO_x emissions assuming a uniform 30% control efficiency across the board for RACT. This may not be appropriate for some fraction of the sources which are not

subject to NO_x RACT, namely sources with actual emissions above 25 tons/year and with potential emissions below the major source threshold (definition varies from 25-100 tons/year). Since potential emissions is a missing parameter, we can not identify these sources. It is felt however that they are a small minority in the inventory.

(8) Provide a field for a 1995 emission factor (lb/MMBtu) that may be filled in with specific RACT limits later on.

(9) Add totaling to each file for 1990 and 1995 annual and ozone season NO_x emissions.

(10) Provide fields for a 1999 emission factor (lb/MMBtu), 1999 annual and 1999 ozone season NO_x emissions.

Once this task is completed, printed copies of the files will be made available to NESCAUM. Given the budget remaining, I would then propose to go back and refine the inventory using the supplementary data we have collected.

J883SR2

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DATA REQUEST MEMO

To: Michael Bradley, NESCAUM

From: Peter Guldberg, Tech Environmental, Inc.

Date: April 15, 1994

Re: Point Source Inventory Data Request

Here is the final list to be sent to NESCAUM/MARAMA states and the ozone modeling groups:

Pollutant and Year: NO_x for 1990 Baseline Inventory

Size cut-off: All sources in your State (or Modeling Domain) with actual emissions of 25 tons/yr or more.

Type of Source: Any boiler, turbine, engine, incinerator, or fuel combustion source.

Form of Request: Hard copy and 3.5" computer diskette

Source information desired:

- source name
- county, state name
- attainment status and classification if nonattainment
- primary SIC code
- SCC number
- actual hours of operation per quarter in 1990
- any additional information on operation during the summer months used to calculate the "typical ozone day" and "episodic ozone day" emissions. Please define the two terms as used in your inventory.
- equipment capacity (million Btu per hour)
- 1990 NO_x emission rates and units (lb/MMBtu)
- type and quantity of primary fuel combusted
- type and quantity of backup fuel combusted
- 1990 actual emissions (tons/yr)
- capacity in MW for electrical generators
- potential NO_x emissions (tons/yr)
- minor/major classification
- is this source in the power grid? which grid?

A List of New Sources Since 1990

A List of Sources Shutdown Since 1990

A Copy of Your 1995 RACT State Rules

/J883M5

FILE FORMAT FOR EPA OAQPS CD-ROM DATA

Format: Variable	Type	Size	Description
PLANTID	Char	4.0	NAPAP Plant ID code need source name
POINTID	Char	2.0	NAPAP Point ID code
ORISID	Char	5.0	ORIS Plant ID (util. only)
BLRID	Char	5.0	Boiler ID code (util. only)
STKHGT	Num	4.0	Stack Height (ft)
STKDIAM	Num	6.2	Stack Diameter (ft)
STKTEMP	Num	4.0	Stack Temperature (°F)
STKFLOW	Num	10.2	Flow Rate (ft^3/min)
BOILCAP	Num	8.2	Boiler Design Capacity (MMBtu/hr)
WINTHRU	Num	2.0	Winter Throughput %
SPRTHRU	Num	2.0	Spring Throughput %
SUMTHRU	Num	2.0	Summer Throughput %
FALTHRU	Num	2.0	Fall Throughput %
HOURS	Num	2.0	Hours/Day in Operation
DAYS	Num	1.0	Days/Week in Operation
WEEKS	Num	2.0	Weeks/Year in Operation
THRUPUT	Num	11.1	Operating Rate (SCC units/yr)
MAXRATE	Num	12.3	Maximum Design Rate (SCC units/hr)
HEATCON	Num	8.2	Fuel Heat Content (MMBtu/SCC unit)
SULFCON	Num	5.2	% Fuel Sulfur Content
ASHCON	Num	5.2	% Fuel Ash Content
NETDC	Num	9.3	Maximum Nameplate Capacity (MW)
STKVEL	Num	9.2	Stack Gas Velocity (ft/sec)
SCC	Char	8.0	Source Classification Code
FIPST	Num	2.0	FIPS State Code
FIPSCNY	Num	3.0	FIPS County Code
SIC	Num	4.0	Standard Industrial Classification Code
LATC	Num	9.4	Latitude (degrees)
LONC	Num	9.4	Longitude (degrees)
SAROAD1 - 4	Char	5.0	SAROAD Pollutant Code for VOC, NO_x, CO, and SO_2
EMF1 - 4	Num	10.5	Emission Factors for VOC, NO_x, CO, and SO_2 (lbs per SCC unit)
CONEFF1 - 4	Num	7.2	% Control Efficiency for VOC, NO_x, CO, and SO_2
CONPRI1 - 4	Num	3.0	Primary Control Equipment Code for VOC, NO_x, CO, and SO_2
CONSEC1 - 4	Num	3.0	Secondary Control Equipment Code for VOC, NO_x, CO, and SO_2
ESTMET1 - 4	Num	1.0	Estimation Method for VOC, NO_x, CO, and SO_2
EMISS1 - 4	Num	13.4	Emissions (tons/year) for VOC, NO_x, CO, and SO_2 (controlled with rule effectiveness)
RULEFF1 - 4	Num	3.0	Rule Effectiveness % for VOC, NO_x, CO, and SO_2