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The NO_x Budget Trading Program: A Collaborative, Innovative Approach to Solving a Regional Air Pollution Problem

The NO_x Budget Trading Program showed that regional cap-and-trade programs are adaptable to more than one pollutant, time period, and geographic scale, and can achieve compliance results similar to the Acid Rain Program. Here are 11 specific lessons that have emerged from the experience.

Sam Napolitano, Gabrielle Stevens, Jeremy Schreifels and Kevin Culligan

I. Introduction

This article examines the development and implementation of the NO_x Budget Trading Program (NBP) and the lessons the Environmental Protection Agency has learned from this seasonal emissions cap-and-trade program. The NBP affects units in 20 eastern states and the District of Columbia.

For close to 40 years, states have worked to address ground-level ozone problems. Ozone formation results from a complex photochemical interaction of sunlight with air emissions of volatile organic compounds (VOCs) and nitrogen oxides (NO_x). Some of the most acute problems have occurred in the northeastern states and result from local emissions and from interstate

transport of emissions across a broad region.

Federal efforts initially focused on controlling VOC emissions from mobile sources. By the 1990s, researchers found that biogenic VOCs were greater than past estimates, suggesting that further VOC reductions might be less effective in reducing ozone than previously thought. EPA determined that a greater focus on NO_x reductions was needed.

As states implemented policies to address in-state NO_x emission sources, they also expressed concern to EPA that emissions from “upwind” areas had to be addressed in order for them to meet the Clean Air Act requirements for demonstrating attainment with the ozone National Ambient Air Quality Standard (NAAQS).

The Clean Air Act Amendments of 1990 (CAAA) provided a mechanism to focus on the regional nature of the ozone nonattainment problem. Section 184 of the CAAA created the Ozone Transport Commission (OTC) to coordinate action among the northeastern and mid-Atlantic region, including Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia, and the District of Columbia.

As part of its efforts, the OTC jurisdictions signed a Memorandum of Understanding (MOU) to establish a NO_x

emissions cap-and-trade program to control seasonal NO_x emissions from electricity generators and large industrial boilers beginning in 1999, with a lower cap planned for 2003.^{1,2}

The OTC NO_x Budget Program: Capitalizing on the experience of the Acid Rain Program (ARP), the OTC states created the NO_x Budget Program to harness free market forces to reduce pollution. In collaboration with EPA, as well

Emission sources had the flexibility to develop compliance strategies that fit their situation and conditions.

as representatives from industry, utilities, and environmental groups, the OTC states developed a model rule which identified key elements that should be consistent among the regulations in all participating states for an integrated interstate emissions trading program. Under the program, states allocated NO_x emission allowances to emission sources. The emission sources had the flexibility to develop compliance strategies that fit their situation and conditions. Strategies included installing emissions control equipment, switching

fuels or dispatch, and the buying, selling, and banking (saving) of emission allowances. At the end of the summer ozone season (May through September), each emission source had to demonstrate compliance by holding sufficient allowances to offset ozone-season NO_x emissions. However, regardless of the number of allowances a source held, it could not emit at levels that would violate other federal or state limits (e.g., for coal-fired units, New Source Performance Standards, ARP NO_x limits, Title V permit requirements, and Title I requirements for reasonably available control technologies (RACT) for NO_x).

EPA reviewed states' proposed regulations in their respective State Implementation Plans (SIPs) to ensure consistency across the region. EPA also agreed to administer the program's emissions monitoring, reporting, and verification requirements, as well as track emissions and allowance data. Results from the 1999–2002 ozone seasons were impressive: from a 1990 baseline of 473,000 tons, emission sources reduced NO_x emissions by 60 percent, or 280,000 tons.³ The successful and cooperative partnership that developed between EPA and the states served as an important example of a new model to address regional pollution problems requiring a multi-state approach.

The NO_x SIP Call: Recognizing that the OTC effort offered a limited solution to the ozone transport problem in the East, EPA and the Environmental Council of the States decided to form a broad, regional work group to develop consensus solutions to the problem of ozone nonattainment. The Ozone Transport Assessment Group (OTAG) was established in May 1995 to address the shared problem of transport across state boundaries. OTAG was a partnership between EPA, the 37 eastern states, and the District of Columbia, industry representatives, and environmental groups that completed what was, at that time, the most comprehensive technical analyses of regional ozone transport ever conducted, using new air quality modeling tools.⁴ Since that time, air quality modeling tools matured to allow analyses to project impacts of emissions and predict improvements from emission reductions decades into the future. These tools underlie EPA's major rules for mobile sources, the power sector, and other sources.

In September 1998, EPA finalized the "Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone." This rule – commonly called the "NO_x SIP Call" – was designed to lower the interstate



Source: EPA

Figure 1: NO_x SIP Call Region.

transport of NO_x. In the rulemaking, EPA showed that NO_x emissions in 22 states (now 20 due to a court decision) and the District of Columbia contributed to nonattainment of the ozone NAAQS in downwind states, or interfere with a state's ability to maintain that standard⁵ (Figure 1).

Under the NO_x SIP Call, states were required to issue regulations to reduce seasonal NO_x emissions at or below the state's emission budget. States had the flexibility to develop compliance strategies that best suited their circumstances. EPA made available an option of an EPA-administered cap-and-trade program covering electric generators and large industrial sources as a highly cost-effective means of meeting most of the SIP Call emission reduction requirements. All of the affected jurisdictions chose to participate in the regional cap-and-trade program.

Litigation led to the program starting May 31, 2004, for most of the states (Missouri entered the program in 2007).⁶ However, the OTC states retained the original compliance date of May 1, 2003, and transitioned to the SIP Call at that time since similar cuts already had been envisioned under the third phase of the OTC NO_x trading program.

II. Design of the SIP Call NO_x Budget Trading Program

The SIP Call's NO_x Budget Trading Program (NBP) was designed to complement other federal, state, and local control activities and, as such, built on previous efforts to reduce NO_x emissions. It is buttressed by a number of air quality tools in the Clean Air Act, together representing the Act's approach to protecting air quality. These include the Reasonably Available Control Technology (RACT) Title I

program starting in 1994 and the Acid Rain Program NO_x reduction program (Title IV) beginning in 1996.⁷ The existing Clean Air Act programs provided high-quality emission data for electric generators and information about emission reduction strategies that helped strengthen the NBP's design elements.

A regional NO_x emission budget was determined by EPA and divided among the states. States had the obligation to meet their budget but were free to determine how and which sources would be required to reduce emissions to meet the limit. EPA encouraged states to consider electric power generator and large boiler controls under the NBP. The NBP allowed states to achieve over 90 percent of the required reductions in a highly cost-effective way. For example, for electric generators, EPA chose an average control level (0.15 lbs per million British thermal units, or mmBtu) to develop an emission cap, which was achievable using available, cost-effective technology and which corresponded to the most protective level recommended by OTAG. For

other sources, EPA chose an average control level representing a 60 percent reduction from uncontrolled levels for large industrial boilers and turbines, a 90 percent reduction from stationary combustion engines, and a 30 percent reduction from cement kilns (Figure 2). Overall, in the final SIP Call rule, the NBP mandates regional ozone season NO_x reductions of 1.2 million tons, or 28 percent of the total NO_x inventory, at full implementation.

Similar to the OTC NO_x budget program, EPA provided a model rule (40 CFR Part 96) for states. The model rule offered a complete trading program, including provisions for allowance allocation methodologies, monitoring and reporting requirements, allowance banking, trading protocols allowing unrestricted trading across jurisdictions, non-compliance penalties, and program administration. States had the ability to modify certain provisions within the model rule, such as allowance allocation approaches; other critical

provisions were required of all states without modification, such as emissions monitoring, to ensure the integrity of the trading program.

Each state trading regulation included fossil fuel-fired electric generators greater than 25 MWe and industrial boilers and turbines with heat input greater than 250 mmBtu per hour. States had the flexibility to add smaller sources, so several of the northeastern states included sources between 15 MWe and 25 MWe that had participated in the OTC NO_x budget program. Additional source categories could be added if they met stringent monitoring and reporting requirements. For example, New York included cement kilns and Illinois had a provision in their rule allowing cement kilns to voluntarily participate in the program through an opt-in provision.

The NBP requires compliance with monitoring and reporting provisions similar to those in the ARP.⁸ As with the ARP, emission monitoring is the prerequisite for flexibility and the cornerstone of accountability in the cap-and-trade program. Accurate and continuous monitoring requirements ensure that individual sources are in compliance and validate the integrity of the trading system; consistent reporting requirements facilitate allowance trading and program administration.

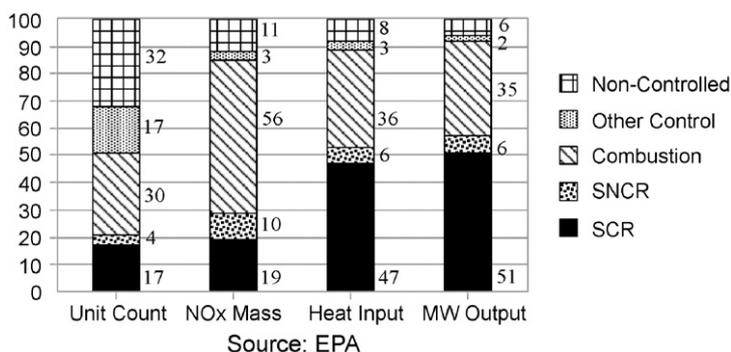


Figure 2: Distribution of Controlled Units and 2006 Ozone Season NO_x Emissions, Heat Input, and Electricity Generation (Output).

There were several special provisions that states could adopt in their basic trading rule, including opt-ins, low-emitting exemptions, set-asides, and a compliance supplement pool. The opt-in provision allowed facilities to voluntarily participate in the program. To qualify, units not already in the program had to meet specific criteria, including establishing an emission baseline by monitoring a year before opting in. All the states incorporated the opt-in provision in their model rules.

Another provision, the little used but highly complicated provision known as the 25-ton exemption, allowed certain low-emitting NO_x combustion sources to agree to an operating hour limit in exchange for an exemption from the program if they produced less than 25 tons of NO_x during the control season. About half the states chose to include this provision.

The set-aside provisions gave states the option to reserve a portion of their budget for new units and energy efficiency/renewable energy (EE/RE) projects to encourage conservation. The size of the set-asides varied by state. All the states except Delaware provided a new-unit set-aside for sources and about six states included EE/RE set-asides. The EE/RE program provided incentives to catalyze investments in projects and offered states additional flexibility in implementing their NO_x attainment strategy. If the set-asides were not fully subscribed,

as was the case with the EE/RE programs, most states returned the allowances to regulated sources on a pro rata basis. Some states (Kentucky, Virginia) also set aside a small portion of allowances for auction rather than freely allocating them to regulated sources.

Another unique and experimental feature of the NBP was the compliance supplement pool (CSP). In response to

Since EPA will not administer the NBP after 2008, states must take regulatory action to continue to meet their NO_x SIP Call obligations.

concerns that emission sources might not be able to install emission controls by the compliance deadline, and thus might not be able to provide the necessary electricity during the high-demand periods of the hot summer months, the NBP created a pool of allowances that each state could use based on strict criteria. States could issue the allowances to emission sources that achieve their emission reductions earlier than required or to emission sources that demonstrate the program would place a burden of risk on the emission source and potentially impact delivery of electricity. This pool of allowances

encouraged early compliance, but also provided significant flexibility by making these allowances available for sources that might not otherwise meet the compliance deadline. In addition, some OTC states were awarded CSP allowances in lieu of their banked OTC NO_x budget program allowances during the transition to the NBP. It is important to note that the CSP allowances were only valid for compliance during the first two years of the program: 2003–2004 for OTC states, and 2004–2005 for the other states.

Since EPA will not administer the NBP after 2008, states must take regulatory action to continue to meet their NO_x SIP Call obligations. One choice is to participate in the Clean Air Interstate Rule (CAIR) NO_x ozone season trading program, expanded to cover all units that would otherwise be covered by the state's NO_x SIP Call trading program, beginning in 2009. CAIR builds upon the Acid Rain and the regional NO_x trading programs by using a multi-pollutant control approach to help states address NAAQS attainment for both ozone and particulate matter smaller than 2.5 microns (PM_{2.5}) by reducing transported SO₂ and NO_x precursors. CAIR accomplishes this by creating three separate trading programs for power plants: an annual NO_x program, an ozone season NO_x program, and an annual SO₂ program. Similar to the NO_x SIP Call, all affected CAIR states have chosen to participate in the cap-and-trade programs for SO₂ and NO_x.⁹

Comparison with Title IV's Cap-and-Trade Program

COMPARING THE ACID RAIN AND SIP CALL NO_x BUDGET TRADING PROGRAMS

Form and Coverage: Both the Acid Rain Program (ARP) and the SIP Call NO_x Budget Trading Program (NBP) are cap-and-trade systems using emission allowances as the trading currency. Both programs focus on electric generators greater than or equal to 25 MWe but some states in the NBP chose to include sources as small as 15 MWe. In addition, the NBP affects a set of industrial sources that are not affected by the ARP. There is the potential for non-affected sources to opt-in to both programs, although NBP states had the option of restricting opt-ins through their state trading rules.

Monitoring: Affected units are required to install continuous emission monitoring systems (CEMS), except where approved alternative monitoring methods are allowed.

Geographic and Temporal Scope: Both programs address a pollutant's long-range transport. The ARP addresses the accumulation or total loading of SO₂ in the atmosphere, which falls to the ground as acidic deposition. The NBP is concerned with the seasonal nature of ground-level ozone formation, and acts to reduce the concentrations of NO_x – an ozone precursor – so that exceedances of the ozone NAAQS are less frequent and less severe. The ARP is year-long and continental in scale whereas the NBP is seasonal (May-September) and regional.

Regulatory Authority: The ARP was required under Title IV of the CAAA and was promulgated by EPA for the contiguous United States. The NBP was developed to help eastern states meet their obligations under Title I of the Clean Air Act to attain the ozone NAAQS. Unlike the ARP, each of the jurisdictions affected by the NO_x SIP Call promulgated their own regulations based on a model rule, which EPA reviewed for consistency and approved. EPA centrally administers the NBP for all states.

Allowance Allocations: In the ARP, allocations were based on a series of formulas established by Congress, and are applied uniformly according to statutory criteria. In the NBP, the emissions cap was divided among the states by EPA's consideration of sources' energy use and other factors, and the allocation methodology was left up to the state (EPA reviewed and approved all methodologies as part of the SIP approval process). The ARP also provided for allocations in perpetuity and EPA records allowances in facility accounts 30 years into the future. In the NBP, states could decide on the number of years (usually three to five) of allowances allocated to a source at one time.

Allowance Banking: Both programs allow unlimited banking. However, the NBP employs a provision called Progressive Flow Control (PFC) wherein a certain percentage of allowances must be surrendered for compliance at a 2:1 ratio under conditions where the regional bank of allowances is greater than 10 percent of the region's budget.

Compliance: Both programs initially included unit-level accounting systems with certified account representatives, and general accounts for others to purchase allowances. Both programs utilize a reconciliation process through which allowances are deducted for a source's emissions. Most NBP states permitted overdraft accounts to help with unit-level compliance. The ARP program recently migrated to facility-level compliance based on lessons learned from the NBP. Both programs have automatic penalties. In the ARP, the number of allowances equivalent to the tons of excess emissions are deducted from the next year's allocation. In addition, a monetary fine must be paid at the rate of \$2,000 per ton (1990\$), adjusted annually for inflation. The NBP required an automatic deduction of three allowances from next year's allocation for every excess ton of NO_x emissions, but no direct monetary penalty. Under each program, sources are also subject to discretionary penalties for civil and criminal violations.

III. Lessons

Following the last four years of EPA and state experience implementing the NO_x Budget Trading Program, important lessons have emerged.

Lesson 1 *The Program works: substantial emission reductions have occurred throughout the states and across the region, quickly leading to dramatic improvements in air quality.*¹⁰

As seen in the ARP, setting strict rules for accountability and allowing industry flexibility to develop custom strategies to reduce emissions yields results at significantly lower costs. As of 2006 (with 19 states and the District of Columbia in the program), summer season NO_x emissions were reduced by about 730,000 tons, or 60 percent (Figure 3), the program has lowered average ozone levels (concentrations) in the NO_x SIP

Call region between 5 and 8 percent since 2000 and, more important, daily peak levels of ozone critical to compliance with

the NAAQS have dropped.¹¹ Currently 80 percent of areas designated nonattainment in the East in 2004 have air quality better

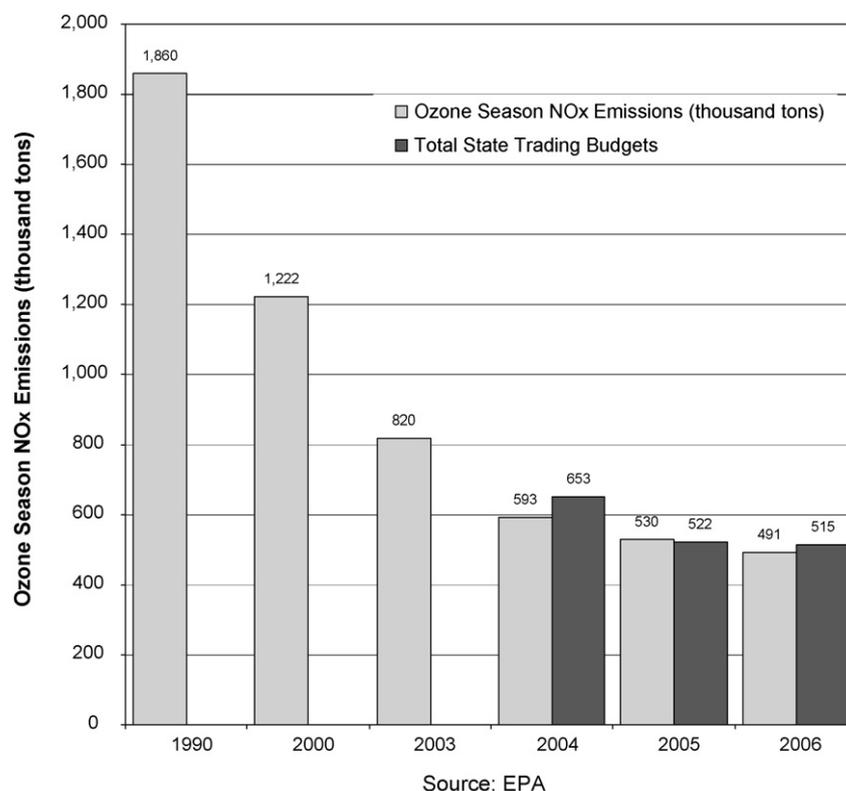


Figure 3: Ozone Season NO_x Emissions 1990, 2000, 2003, 2004, 2005, 2006.

than the NAAQS,¹² much of this progress is attributable to the NBP. CAIR, which will begin in 2009 for NO_x, is projected to complement other federal programs covering a wide range of mobile sources, and many state actions, leading to further gains.

Lesson 2 *EPA demonstrated its authority under Title I of the Clean Air Act Amendments to implement regional cap-and-trade programs that mitigate transport of interstate pollution and provide large emission reductions*

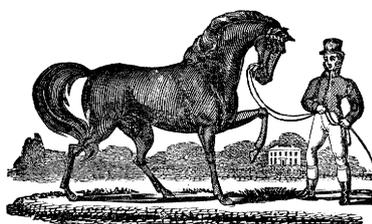
The NO_x SIP Call faced legal challenges by several states and other organizations seeking to overturn the regulation. The court upheld EPA's position and EPA was able to establish that it has the authority under Title I to set up emission cap-and-trade programs to address interstate transport of pollutants covered by the NAAQS. CAIR is based on this authority of EPA to assist states by addressing trans-boundary movement of air pollutants.

Lesson 3 *Cap-and-trade is effective in controlling emissions from sources beyond the power sector.*

Emissions that contribute to the formation of ground-level ozone are attributable to a wide range of sources. Because power plants were responsible for approximately 20 percent of NO_x emissions from stationary sources, EPA provided the states the option to include large industrial boilers, cement kilns, and/or process boilers. If a state chose to include a source category, the state is

required to include all sources in the category to ensure that emissions were not shifted to sources outside the program. Industrial sources are required to meet the same stringent monitoring standards and must hold sufficient allowances to offset ozone-season NO_x emissions.

All states chose to include industrial sources in the NBP.



Since 2003, industrial sources in the NBP have reduced emissions by approximately 35 percent, demonstrating that their inclusion provided additional cost-effective emission reductions.¹³ EPA has found that, like the power sector, industrial sources can manage sophisticated monitoring and reporting systems successfully.

Lesson 4 *A simple program is better than a complex one.*

ARP legislation centralized administrative aspects of the trading program with EPA to maximize efficiency and effectiveness. This was not so easily done with the regional regulations that defined the NO_x trading programs.

Under the NO_x trading program, EPA and the states agreed to more closely manage emission reductions through provisions such as progressive flow control, new source set-asides, and overdraft accounts. These provisions added complexity to the program without delivering the anticipated benefits.

Progressive flow control discounted allowances at a 2-to-1 ratio when the regional bank of allowances reached 10 percent of the overall regional budget. Each year flow control was calculated and sources knew a few months ahead of the next control season what percentage of their banked allowances could be used on a 1-to-1 basis and what portion would be discounted. EPA examined the use of this mechanism and found it added very little to the program's effectiveness.¹⁴ This remains a confusing and difficult aspect of the trading program which was not carried forward in the CAIR trading programs.

New units that had not operated previously could apply for allowances from a state's new-unit set-aside account based on projected emissions. States then "took back" the difference between a new unit's projected and actual emissions. In some cases, new units found themselves out of compliance. Each state had different set-aside provisions which burdened the program administration. Since EPA managed the tracking of all state budgets, this additional

complexity also affected annual reconciliation.

Another example involved the introduction of overdraft accounts in all NBP states (except New Jersey) for facilities with two or more units. This was expected to provide compliance security for individual units and flexibility in how they managed their allowances by allowing them to tap into any allowances transferred to the facility-level overdraft account. Use of the overdraft account is optional. The automatic 3-for-1 allowance penalty applies to sources that do not hold enough allowances to cover their emissions for the ozone season. Ensuring that each unit account in the tracking system holds enough allowances for annual compliance is basically an accounting exercise for the company's Designated Representative. Nevertheless, there have been a number of cases where a source had sufficient allowances at the facility level, but failed to put them in the correct unit compliance accounts or to use the overdraft account. Again, the complexity for both the regulator and source was more than expected and impeded the efficiency of the program operation.

However, experience with unit-level compliance accounting led EPA to propose facility-level compliance for the CAIR trading programs and, in the course of enacting the CAIR regulations, provided an opportunity for EPA to switch the ARP from unit-level to facility-level compliance.

Facility-level compliance uses a single facility allowance account and can help prevent costly administrative errors. Facility accounts have the added benefit of reducing the number of allowance transfers required to balance the books at the end of the compliance period. This saves both the company representatives and EPA time and effort in



recording and keeping records of these transfers. It also simplifies compliance for situations with a common emission stack by eliminating the need to apportion emissions to each unit, which is necessary when doing unit-level compliance.

Finally, it is worth noting that during the design and promulgation period of the NBP, EPA was encouraged to modify the trading program in specific ways that were deemed to increase its cost-effectiveness. EPA considered the value of creating multiple trading zones with emission caps that were based on the relative significance of the ozone problem in each zone, and devising a trading scheme that

weighted the value of emission allowances by the holder's contribution to the ozone problem. Such a scheme was thought to encourage the greatest emission reductions from power plants and other sources that contribute most to the problem. EPA found that these conceptually elegant approaches did not substantially lower costs for meeting the program's objectives.^{15,16} Therefore, EPA kept the single-trading-region program that has proven in a short period of time to be simple, efficient, and highly cost-effective.

Lesson 5 *Accurate baseline emission inventory information is critical to effective program design.*

EPA and states had high-quality power sector emission information before the start of the NO_x Budget Trading Program as a result of requirements for continuous monitoring and quarterly emission data reporting under the Acid Rain Program, especially for coal-fired generation which dominates NO_x emissions from the power sector. Data for other sectors such as some industrial sources was not as accurate or robust. As a result, allocations tended to be inflated for the non-power sector sources, which in turn were easily able to meet the requirements of the NBP and, in general, became net sellers of the overallocated allowances. This points up the importance of having good data when a program is designed to ensure that the control strategy achieves regulatory improvements across the industry it covers. Accurate

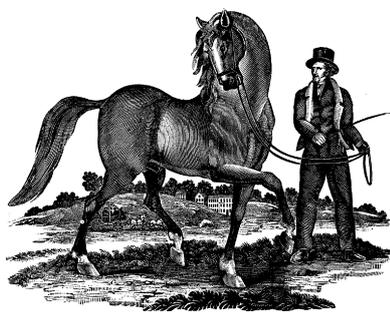
data is also important for the allocation process and critical if used to set the cap or budget.

Lesson 6 *EPA is best at establishing overall objectives, defining key elements, and administering a program, while states are capable of adopting programs to fit local circumstances and addressing distributional impacts of programs.*

EPA's model rule established consistent requirements for minimum applicability – the emission sources that were required to participate in the program. The emission sources included electricity generating units and large industrial boilers and turbines above a certain size threshold – greater than or equal to 25 MWe or 250 mmBtu per hour of heat input. As mentioned above, states also had the option of including smaller electricity generating units and other industrial source categories. Emission monitoring, reporting, and verification requirements had to be consistent across all states as are the rules for trading, compliance requirements, compliance schedule, and minimum non-compliance penalties. EPA also distributed the overall regional budget among the states.

EPA's model rule included a sample allocation process, but states were free to devise their own allocation approaches. While the allocation approach should not affect either the ability of the program to achieve the environmental goal or the liquidity of the market, the outcome of the allocation process

can have important distributional impacts and, therefore, economic consequences. Different allocation methods can reward some behaviors or sources at the expense of others. Consequently, EPA left the decision on how to allocate allowances to the states. Many of the states adopted the default approach provided by the model rule. However, several



states adopted different approaches, including even auctioning some of the allowances. A handful of states allowed the emission sources to work with them to develop the allocation methodology through a consensus decision-making process.

Some states have opted to develop “updating” allocation approaches with new source set-asides to provide allowances for new emission sources. Under an updating approach, allocations are recalculated after a specified period, usually three or five years, based on current, monitored emission data. After an update, the new allocations reflect the addition of new emission sources,

shutdown of emission sources, and, depending on the methodology used to recalculate the allocations, changes to fuel use or output (e.g., generation or production). After four years of NBP operation, the variety of allocation approaches has not had an effect on the achievement of the emission target or the liquidity of the market. But allowing states the flexibility to develop different allocation approaches gives them an opportunity to address local economic distributional issues. EPA also found that states are very adept at getting the allocations in place, working well with their smaller stakeholder groups, to set up acceptable programs. At the federal level, this issue has required considerable effort for EPA in the context of CAIR, and for Congress when it set up Title IV of the CAAA (Acid Rain Program) in 1990.

Lesson 7 *There does not appear to be evidence of local concentrations of emissions (or hot spots) as a result of regional cap-and-trade programs.*

While EPA is concerned about local air quality issues, it is important to remember that the goal of the NBP was to achieve reductions across the region to reduce the transport of NO_x emissions. By achieving significant reductions on a regional scale, cap-and-trade programs improve local air quality. However, eliminating high, localized emission concentrations is not their primary purpose. States and local governments retain the authority (and have the responsibility) to

enact source-level requirements to reduce emissions from specific emission sources that contribute to localized air quality problems. Analysis that EPA has conducted over the years has demonstrated that the areas with the highest emissions attain the greatest reductions. Research has not found evidence of localized increases in pollution as a result of the NBP or ARP cap-and-trade programs.¹⁷

Lesson 8 *EPA found that the pace of implementation matters and it is valuable to consider phasing in emission reduction requirements.*

When developing the NBP, EPA recognized that the need to achieve significant reductions quickly had to be balanced with industries' ability to install the necessary emission controls in time to meet those requirements. Detailed analysis by EPA indicated that industry could comply by spring, 2003. However, delay of action by the power industry during litigation led to a significant short-term increase in the price of emission control equipment in response to the short-term demand, as facilities rushed to install controls during 2001–2003. The shortages of labor, materials, and some equipment drove up costs considerably. EPA considered similar factors in developing the timing and emission reduction requirements for CAIR, with the first phase reductions for NO_x and SO₂ in 2009 and 2010, respectively, and tighter controls in 2015 for both pollutants. While there is also CAIR litigation, many companies

are acting proactively to install emission controls rather than delaying those installations until there is a court decision.

Lesson 9 *EPA made the regulated community clearly responsible for emission reductions, but allowing considerable freedom on how to comply led industry to devise highly cost-effective control strategies that reduced emissions over time.*



Although post-combustion pollution control costs for selective catalytic reduction (SCR) and other equipment were more expensive when companies delayed their installations until shortly before the NBP began, the overall costs of the program by 2006 (the fourth year of program operation) were much lower than EPA had expected. When EPA forecasted NO_x allowance values in 1998 for the NBP's initial years of operation, the prices reflecting the marginal cost of compliance were over \$5,000 per ton (in 2006 dollars). In the 2006 ozone season, spot prices for allowances were less than half that amount while companies in the program

emitted NO_x at levels close to the emissions cap.

The leading reasons for this appear to be that companies have been able to make SCR controls, the leading technology for post-combustion NO_x treatment, and simpler combustion controls work much better than experts expected once the program was underway. The trading program provided the incentive to push these technologies further, freeing up allowances for direct sale and/or lowering allowance needs, something that does not occur with direct command-and-control regulations. Additionally, companies had the flexibility to dispatch cleaner units with lower compliance costs more often and operate uncontrolled units less, if at all, during the ozone season in order to minimize total costs across their set of units covered by the program.

Lesson 10 *Although the NBP provides considerable compliance flexibility, the level of compliance is extremely high with a limited number of government staff involved in program administration.*

As with the Acid Rain Program, compliance with the NO_x Budget Trading Program allowance holding requirements for ozone season NO_x emissions has been extraordinary. Over the last three years of full implementation (2004–2006), companies utilizing a wide range of compliance strategies and an active allowance market have achieved a compliance rate of over 99 percent from both the power industry and

other industry participants. Approximately 20 full-time staff ensure program compliance through the efficient management of emissions monitoring, reporting, and verification; allowance tracking; and compliance assistance and assessment.

Lesson 11 *EPA finds that Congressional direction makes it easier to set up and implement cap-and-trade programs.*

Experience implementing the Acid Rain Program and the NO_x Budget Trading Programs shows that Congressional direction with clear goals and program elements make a program easier to implement. Basic aspects of the Acid Rain Program were unquestioned and implemented in a straightforward way without delays. Complex and sensitive allocation decisions were made by Congress. For these reasons, EPA advocated for Congress to provide multi-pollutant legislation and, in lieu of that result, devised CAIR using its authority under Title I of the CAAA. EPA still believes that multi-pollutant legislation is desirable, particularly in providing greater certainty for industry and for environmental protection.

IV. Conclusions

The NO_x Budget Trading Program showed that regional cap-and-trade programs are adaptable to more than one pollutant, time period, and geographic scale, and can achieve

compliance results similar to the Acid Rain Program. The OTC NO_x budget program was also an important example of cooperation between states, regional planning organizations, and EPA. The NBP further demonstrates how EPA and states can work together to identify and implement solutions to address pollutant transport across state boundaries that impacts public health and the environment. The program demonstrates that industries in addition to the power sector can effectively participate and that keeping rules simple and clear delivers value. This market-based approach has led to highly cost-effective improvements in air quality in the eastern United States, with dramatic improvements in attainment of the ozone NAAQS.

EPA hopes that Congress and others will consider these lessons in their deliberations on how to address air emission problems in the future. These trading programs, along with regulations for mobile sources and other state and local actions, will continue the cooperative momentum among states and EPA to attain both the ozone and PM_{2.5} national standards, and to reduce regional haze and acid deposition. ■

Endnotes:

1. Memorandum of Understanding Among the States of the Ozone Transport Commission on Development of a Regional Strategy Concerning the Control of Stationary Source Nitrogen Oxide Emissions, signed Sept. 27, 1994.

2. Virginia did not sign the MOU and Maine and Vermont were not part of the trading program.

3. EPA and Ozone Transport Commission, *Ozone Transport Commission NO_x Budget Program: Progress Report 1999–2002*, EPA-430-R-03-900, March 2003.

4. See 63 FR 57356, Oct. 27, 1998.

5. *Id.*

6. See *Michigan v. EPA*, No. 98–1497 (Mar. 3, 2000).

7. See Napolitano, *et al.*, *The U.S. Acid Rain Program: Key Insights from the Design, Operation, and Assessment of a Cap and Trade Program*, ELEC. J., Aug. 2007, for information about the Acid Rain Program's NO_x program.

8. EPA, *Plain English Guide to the Part 75 Rule*, Sept. 2005.

9. For more information on CAIR, visit www.epa.gov/airmarkets/progsregs/cair/index.html.

10. EPA, *2006 NO_x Budget Trading Program (SIP Call) Progress Report*, Sept. 2007, at <http://www.epa.gov/airmarkets/resource/nox-resource.html>.

11. Data adjusted for weather.

12. *Id.*

13. See March 2004 Discussion Paper at: <http://www.epa.gov/airmarkets/progsregs/nox/docs/industrial.pdf>.

14. See March 2004 Discussion Paper at: <http://www.epa.gov/airmarkets/progsregs/nox/docs/flowcontrol.pdf>.

15. See Regulatory Impact Analysis supporting the NO_x SIP Call rule of Sept. 1998, available at <http://www.epa.gov/ttn/naaqs/ozone/rto/sip/related.html>.

16. See Dr. Gary Dorris *et al.*, *Development and Evaluation of a Targeted Emission Reduction Scenario for NO_x Point Sources in the Eastern United States: An Application of the Regional Economic Model for Air Quality (REMAQ)*, Nov. 24, 1999.

17. See March 2004 Discussion Paper at <http://www.epa.gov/airmarkets/progsregs/nox/docs/localtrends.pdf>.