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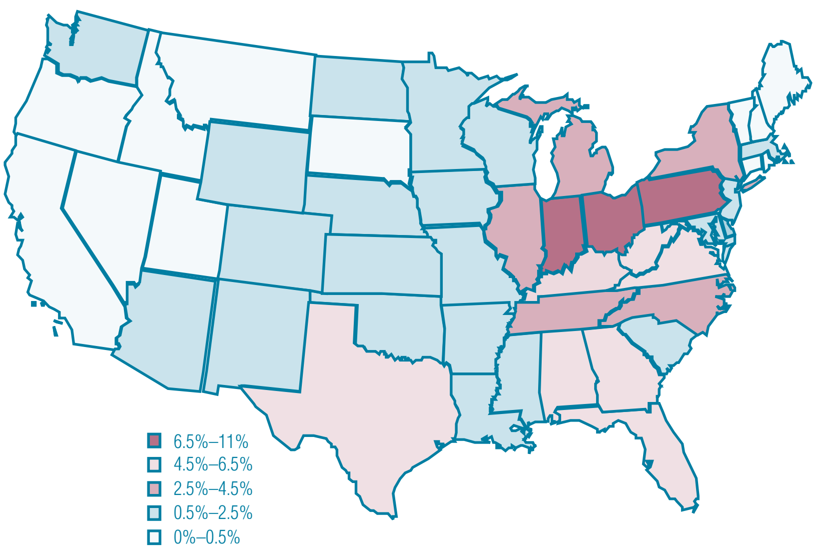
From Market Failure to Market-Based Solution: Policy Lessons from Clean Air Legislation

by Eduard A. Pelz and Terry J. Fitzgerald

FIGURE 1 STATES' SHARES OF NATIONAL SULFUR DIOXIDE OUTPUT, 2000[a]



a. Emissions from all plants covered under Title IV of the 1990 Clean Air Act Amendments.
SOURCE: Environmental Protection Agency, *Clean Air Markets Program Emissions Scorecard 2000*, Appendix A and Table A2.

How can the United States balance its need for increased energy production with national and global environmental concerns? This *Economic Commentary* argues that competitive markets can be used to address environmental needs without placing an excessive burden on citizens.

Energy policy in the United States has once again taken center stage in politics, in the media, and in our daily lives. California's electricity shortage, along with dramatic increases earlier this year in natural gas and gasoline prices, has re-ignited a national debate on the need for increased energy production. At the same time, national and global environmental concerns about the by-products of energy production and consumption continue to build.

Policymakers face the difficult task of creating regulations that both accommodate the steadily rising demand for energy and address the associated environmental hazards. Competitive, unrestricted energy markets are often viewed as part of the problem, implying that restricting market forces through government mandates is part of the solution. This is one view of the current situation in California.

This *Commentary* takes an opposing view, arguing that competitive markets should not be seen as the enemy; rather, they can be a valuable ally in formulating effective energy and environmental policies. We argue that markets can be used to address environmental concerns without placing an excessive burden on citizens through dramatically higher energy prices or a sustained economic slowdown.

The history of clean air legislation in the United States provides an excellent case study of the effectiveness of market-based environmental policy. Here we focus specifically on legislation intended to lower sulfur dioxide (SO_2) emissions, one of the main contributors to acid rain.

Acid rain legislation is of particular interest in the Fourth Federal Reserve District. The states that comprise the Fourth District—Ohio, Pennsylvania, Kentucky, and West Virginia—have accounted for roughly one-third of national SO_2 emissions since 1980 (see figure 1). Ohio has been the single largest producer of SO_2 during this time period, averaging about 12 percent of the national total. Clearly, policies intended to reduce SO_2 emissions will have a disproportionate impact on our regional economy.

The Economics of Clean Air

While competitive markets generally provide an unparalleled mechanism for pricing and allocating resources, there are situations in which markets can produce inefficient or undesirable outcomes. Such market failures are often the rationale for government intervention. But even when market failures exist, intervention does not guarantee a better outcome. Intervention can, in fact, lead to substantially worse outcomes.

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In the case of energy production, market failure stems from what economists refer to as a *negative externality*: Some costs of generating electricity are not borne by the producers. One such cost is that a harmful by-product—pollution—is created in the process. Yet producers do not pay for the adverse effects of their emissions, which results in a misallocation of resources from a societal point of view. Specifically, too much pollution is likely to be generated.

Historically, air pollution legislation has used one of two general approaches, "command and control" or "cap and trade." Command-and-control strategies typically require a specific action be taken and are enforced by regulatory agencies. Examples include limits on the amount of lead in gasoline and the requirement that cars use catalytic converters.

Cap-and-trade programs, on the other hand, do not mandate specific behaviors. Instead, they cap the total allowable pollution and provide an equal amount of "allowances" or "rights" to emit a specific quantity of pollution. Each producer decides how much electricity to produce and how to produce it, but they must own or purchase pollution allowances covering their individual emissions. In other words, the cap-and-trade strategy creates a new market (in pollution rights) to address failures in the existing market.

Economists have long argued that cap-and-trade strategies are, under the right circumstances, a cost-effective way to abate pollution.[1] The economics are straightforward: Producers face varying costs of lowering pollution emissions. Clearly, it is more cost effective to allow producers who can reduce their pollution cheaply to do the bulk of the abatement, rather than forcing all producers to abate equally. With marketable pollution allowances, those that can reduce emissions at the lowest cost will do so, while those facing high treatment or prevention costs can purchase additional pollution allowances on the open market.

The key to any successful pollution-control program is to correctly align economic incentives with the desired pollution-abatement outcomes. Relying on the good will of producers and their shareholders to voluntarily adopt costly abatement procedures in the face of market competition is unrealistic. Therefore, the program must offer the proper incentives—incentives that will lead producers, behaving in their own best interest, to achieve the abatement goals.

Lessons from the 1970s Legislation[2]

Clean air legislation of the 1970s was dominated by a variety of command-and-control programs. At best, this legislation had mixed results, and, at worst, it exacerbated pollution by creating incentives that increased SO_2 emissions or accentuated their effects.

The 1970 Clean Air Act Amendments limited the emissions of all *new* electric-generating facilities to a fixed rate per unit of heat input (a measure of the amount of fuel burned to generate electricity). The amendments created a significant discrepancy between the amount of emissions that new generating facilities could produce and the amount that facilities built before the legislation could produce. It was thought that emissions could be reduced through normal plant attrition as existing facilities—which often had much higher emission rates—were replaced by newer, more efficient plants. In retrospect, it is not surprising that "normal" plant attrition did not occur during this period; in fact, grandfathering the existing plants created such powerful financial incentives that many continued to operate far longer than expected.

The 1970 act also required states to develop plans that outlined the actions they would take to meet the new standards. As part of their plans, some states mandated that tall smokestacks be built at certain plants to disperse emissions over a wider area, thereby reducing local SO_2 concentrations. The tall stacks did reduce SO_2 locally, but they often increased pollution in other areas. Ironically, they also carried emissions higher into the atmosphere, facilitating the chemical processes that cause acid rain.

The 1977 Clean Air Act Amendments adopted a "percent reduction" formula, which required the removal of a percentage of *potential* SO_2 emissions, determined by the sulfur content of the fuel. This effectively required all new coal plants, regardless of their actual emissions, to remove sulfur from their postcombustion exhaust by a process called flue-gas desulfurization, or "scrubbing," which requires extensive capital investment.[3] Because the revised 1977 amendments required lowering *potential* SO_2 emissions, the relatively inexpensive strategy of switching to coals with lower sulfur content (and thus lower SO_2 emissions) would no longer satisfy the requirements.

While hindsight makes the flaws in this early legislation clear, the difficulty of forecasting such flaws should not be underestimated. This is especially true of rigid command-and-control strategies. The Acid Rain Program created by the 1990 Clean Air Act Amendments represented a different approach to pollution abatement, away from the command-and-control strategies of the 1970s and toward a more flexible, market-based approach.

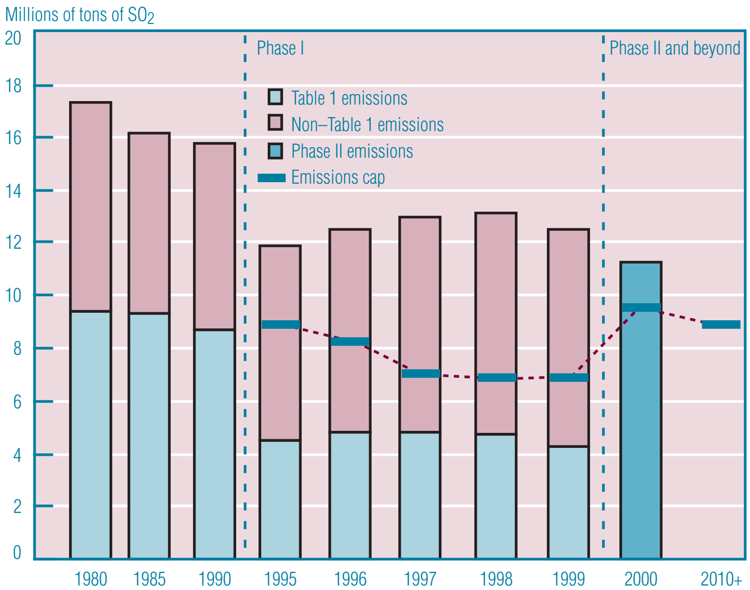
Lessons from the 1990 Clean Air Act Amendments

Title IV of the 1990 Clean Air Act Amendments was the first significant attempt to use marketable pollution allowances—a cap-and-trade strategy—to reduce pollution. Title IV established the Acid Rain Program, which sought substantial reductions in SO_2 and was to be accomplished in two phases (beginning January 1, 1995, and January 1, 2000) with progressively stricter emissions standards.

The goal of the SO_2 emissions-trading program was to reduce aggregate national emissions to about half their 1980 levels—around 18 million tons—by 2000, and to limit annual emissions to roughly 9 million tons thereafter. Pollution allowances, which authorize the holder to emit one ton of SO_2 during or after the issuing year, were allocated to plants that were required to participate. Allocation was based on historic heat input multiplied by a prescribed emission rate (though numerous special provisions provided exceptions to this rule). Compliance required each source to remit allowances equal to their annual output of SO_2 at the end of each year. Extra allowances could be "banked" for future use or sold on the open market.

During Phase I, 261 high-emission, mostly coal-fired generating units (referred to as "Table 1 units," after the legislation) were required to participate. Phase II expanded the program's coverage to include about 1,600 new units and more than halved the emission rate used to calculate allowance allocations.[4]

FIGURE 2 EFFECTS OF THE 1990 CLEAN AIR ACT AMENDMENTS ON NATIONAL SULFUR DIOXIDE OUTPUT



SOURCES: Emissions data are from the Environmental Protection Agency, *Clean Air Markets Program Emissions Scorecard 2000*, Table A2, excepting 1995 and 1996, which are from the EPA's 1996 *Acid Rain Program Compliance Report*. Allowance data are from the 1995–99 *Acid Rain Program Compliance Reports.* Phase I, Table 1 emissions are from the EPA *Clean Air Markets Program Emissions Scorecard 1999.*

The program's success is evidenced by a striking statistic: Table 1 units reduced SO_2 emissions from 9.4 million tons in 1980 to 4.3 million tons in 1999 (see figure 2). Furthermore, all participants were fully compliant throughout Phase I. SO_2 emissions at Table 1 units dropped nearly 40 percent in the first year alone, from 7.4 million tons in 1994 to 4.5 million tons in 1995. After a slight increase in 1996, they continued their downward trend during the last two years of Phase I. In contrast, SO_2 emissions at non–Table 1 units *increased* nearly 11 percent over the same period.

Why was the SO_2 emissions-trading program so successful in reducing emissions during Phase I? Most analysts attribute its success to the versatility of the market-based system. The program's flexibility allowed producers to take advantage of fortuitous developments that made switching from high-sulfur to low-sulfur coals relatively inexpensive. These developments included declining shipping costs due to deregulation of the transportation industry and lower-than-expected modification costs at high-sulfur-generating units. More than half of Table 1 units used fuel switching or fuel blending to achieve SO_2 reductions in 1995, accounting for 59 percent of total reductions.[5]

There is a great deal of evidence that producers behaved exactly as the theory predicted. First, many electric utilities took advantage of the unexpected cost savings from switching to low-sulfur coal. Second, producers followed vastly different strategies to meet the requirements—almost certainly due to differing costs of pollution-abatement strategies. On average, generating units chose to overcomply (that is, reduce their emissions below the number of allocated allowances) by 29 percent per year during Phase I. A handful of electric utilities dramatically reduced their emissions, allowing them to sell their pollution allowances to producers who chose little or no abatement, or to bank them for future use during Phase I or during the more stringent Phase II that began in 2000. In fact, four plants accounted for 25 percent of the overall emission reduction in 1997.[6]

Phase II initiated a new era of SO_2 regulation in terms of emissions standards and scope. Preliminary estimates for 2000 indicate that SO_2 emissions exceeded the 8.9 million ton cap by 22 percent, requiring plants to remit two million banked allowances. The Fourth District alone exceeded its annual allocated allowances by more than 1.3 million tons (63 percent) last year.

It might appear that Phase II will not be as successful as Phase I because the emissions target was exceeded in 2000. However, to say so misses a fundamental point of emissions trading: Compliance is determined by whether a unit remits the requisite number of allowances during a given year—using banked allowances of an earlier vintage is completely acceptable. Emissions cannot exceed the cap for very long because the number of banked allowances is limited and the penalty for noncompliance is much greater than an allowance's current market value.[7] From an environmental perspective, it is more important that *total* Title IV emissions declined more than 10 percent in 2000, despite having exceeded the cap.

Conclusions

Cap-and-trade strategies should not be construed as an environmental panacea. However, the history of clean air legislation clearly demonstrates the usefulness of harnessing market forces to address market failures, and the hazards of inflexible policies that do not adequately consider such forces—a lesson that policymakers would do well to heed.

What is often called "deregulation," for example, did not create unfettered competitive energy markets in California. By installing caps on the retail price of electricity, deregulators likely discouraged investment in new generating capacity. Price caps—along with the larger California regulatory environment—are largely responsible for the state's current dilemma. But one cannot blame markets for bad policy.

Carbon dioxide, a so-called greenhouse gas, provides a similar opportunity to apply the cap-and-trade strategy. The Kyoto Protocol contains just such a provision and, although the United States declined to participate, there is some discussion of U.S. participation in an alternative cap-and-trade program.

Striking a balance between our ever-growing energy needs and environmental protection is a thorny problem. There is inherent tension between these goals, and trade-offs must inevitably be faced. Furthermore, technology, energy demands, and our understanding of the environmental impact of our past and current decisions are all constantly evolving.[8] In this dynamic environment, policymakers must develop flexible policies that effectively address the trade-offs and limit adverse consequences on the economy and its people. Markets should be viewed as a powerful ally in this difficult balancing act, not the enemy.

Footnotes

1. John Dales, *Pollution Property and Prices*, Toronto: University of Toronto Press, 1968.

2. Examples and history are drawn from Denny A. Ellerman et al., *Markets for Clean Air: The U.S. Acid Rain Program*, Cambridge, U.K.: Cambridge University Press, 2000; Richard Schmalansee et al., "An Interim Evaluation of Sulfur Dioxide Emissions Trading," *Journal of Economic Perspectives*, vol. 12, no. 3 (Summer 1998), pp. 56–68; and Energy Information Administration, "The Effects of Title IV of the Clean Air Act Amendments of 1990 on Electric Utilities: An Update," March 1997, DOE/EIA-0582(97).

3. A scrubber, usually a separate facility, passes gas from combusting fuel through tanks containing materials that capture and neutralize the sulfur.

4. See the Environmental Protection Agency's Clean Air Markets Program, www.epa.gov/airmarkets.

5. See Energy Information Administration (note 2). Some emissions reductions would surely have occurred due to the cost effectiveness of fuel switching, even without the Acid Rain Program. Independent statistical analysis estimates that about 36 percent of emissions reductions in 1995–97 are linked to the spread of low-sulfur coal, independent of the Clean Air Act Amendments of 1990 (Ellerman et al. [note 2]).

6. Ellerman et al. (note 2), p. 128.

7. As of July 2001, current-vintage allowances are trading around $200. The penalty for noncompliance is $2,000 per ton of SO_2.

8. One recent study finds that significant declines in acid rain have occurred since the 1970s legislation, but the environment's capacity to neutralize acid has also declined. See Hubbard Brooks Research Foundation, "Acid Rain Revisited: Advances in Scientific Understanding since the Passage of the 1970 and 1990 Clean Air Act Amendments, *Science Links*, vol. 1, no. 1 (2000), pp.1–20.

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