THE CLEAN AIR ACT,

THE ELECTRIC UTILITIES, AND THE COAL MARKET

Congress of the United States
Congressional Budget Office

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NOTES

Except where noted, all dollar figures are expressed in 1980 dollars. All dates are expressed in calendar years.

The projection period analysed begins in 1980 and ends in the year 2000. The most recent year for which most actual data are available is 1979.

PREFACE

In 1981, the Congress began to consider amending the Clean Air Act; that process is still underway. Among the critical areas being examined are the federal standards that regulate air pollutant emissions from new electric power plants using coal. Whether the regulations now in force can control pollutant emissions effectively without imposing undue cost burdens on the utilities and without affecting the distribution of U. S. coal production are critical questions in the Congressional debate.

The Congressional Budget Office has prepared this analysis of these interrelated issues, focusing both on the current standards and four alternative policies that would contribute to abating pollutant emissions from new coal-fired power plants. The study was undertaken at the request of Senator Robert T. Stafford, Chairman of the Senate Committee on Environment and Public Works. In keeping with the CBO's mandate to provide objective analysis, this paper offers no recommendations.

John Thomasian of CBO's Natural Resources and Commerce Division prepared the study, under the supervision of David L. Bodde and Everett M. Ehrlich. The author wishes to express special thanks to Hoff Stauffer of ICF, Incorporated for his assistance in preparing the coal-market analysis, to Johanna Zacharias for assistance in drafting the paper, and to Angela Z. McCollough for typing the manuscript and preparing it for publication. Valuable contributions also were made by Emily W. Fox and Paul Ginsburg of CBO, Richard L. Gordon of Pennsylvania State University, and J. Steven Herod of the U. S. Department of Energy.

Alice M. Rivlin
Director

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CONTENTS

CONTENTS (Continued)

TABLES

93-281 O - 82 - 2

FIGURES

SUMMARY

As the Congress considers revising portions of the Clean Air Act, it confronts the sometimes difficult balance between two federal objectives:

- Achievement and maintenance of environmental quality, and
- Assurance of a reliable and low-cost supply of electricity derived from coal, the nation's most abundant domestic energy source.

At present, coal combustion in utilities furnishes roughly half of the nation's electricity--at the same time emitting nearly two-thirds of all the sulfur dioxide, a gaseous pollutant, released into the United States' atmosphere.

UNDERLYING ISSUES

The Clean Air Act's new source performance standards (NSPS), by regulating pollutant emissions from new power plants, will ultimately bring about a generation of coal-fired facilities that will be markedly cleaner than those supplying most electricity today. By the turn of the next century, the amount of pollution utilities release relative to the volume of fuel consumed will be reduced well below current levels, though the actual quantity of each pollutant, except particulate matter, will continue to grow through the year 2000. Sometime after that date, a measurable reduction in total utility emissions of pollutants should begin to materialize. But because of the very nature of the NSPS, which set standards for new or modified facilities only, much of the emissions control benefit of the regulations lie far ahead.

The Role of the Electric Utilities

The nearer term will largely be a period of investment in cleaner power plants; these will not outnumber their more polluting predecessors for another two or even three decades. The electric utility industry will carry a large share of that air pollution control investment. In complying with the NSPS, utilities burning coal will dedicate some 20 percent of all their capital investment to air pollution control in the next two decades. More than half of this investment will involve meeting the current standards regulating emissions of sulfur dioxide.

The Coal Market's Role

The U.S. coal industry will also play a part, though a more passive one, in pursuing the two federal goals of clean air and energy self-sufficiency. The industry will benefit significantly from the utilities' expanded use of coal. Coal consumption in power plants, the nation's largest coal user, has already risen by 65 percent from 1970 to 1979; over the coming two decades, it will more than double. Not all coal producers will share equally in this boom, however. Western producers stand to achieve a greater gain than their counterparts in the Midwest and East. The Congress has already linked concerns of the coal market to provisions of the Clean Air Act. In the 1982 debate on the act, similar issues will almost certainly recur: What effects will the current or alternative NSPS--particularly sulfur dioxide standards--have on U.S. coal development?

COAL, SULFUR DIOXIDE EMISSIONS, AND NEW SOURCE PERFORMANCE STANDARDS

An intrinsic chemical property of coal--specifically, its sulfur content--directly affects the amount of sulfur dioxide that results from coal combustion. When burnt in a 500-megawatt power plant without emissions control, a high-sulfur coal could generate roughly 91,980 tons of sulfur dioxide a year. Conversely, combustion of a low-sulfur coal in the same power plant could yield roughly 7,665 tons of sulfur dioxide a year. Though coal is produced in all three subdivisions of the country--the East, the Midwest, and the West--sulfur content varies markedly. Eastern deposits contain both low- and high-sulfur coal; midwestern coal ranges from moderate to high in sulfur content; western coal is generally low in sulfur.

The NSPS of 1971

The act's original provisions regulating new source pollutant emissions--eliciting the utility NSPS of 1971, which applied to all new fossil-fuel-fired generators--did not take these differences into account. The 1971 NSPS mandated that the utilities meet a mass sulfur dioxide emissions limit of 1.2 pounds per million British thermal units (BTUs) of coal burnt, as well as placing limits on nitrogen oxides and particulate matter. Utilities could comply by whatever means was most economical, and most elected to burn low-sulfur coal. One result was a slowing of sulfur dioxide emissions growth; a significant reduction in particulate pollution occurred; but there was little success in curbing nitrogen oxide emissions.

Another result, perceived by high-sulfur coal producers and in turn, by the Congress, was that imposition of the NSPS would change the distribution of U.S. coal production--specifically, that the 1971 NSPS could encourage the production and use of abundant low-sulfur western coal over its high-sulfur counterpart in the Midwest. This perception, together with the desire to promote the use of control technology, led to the revisions in the utility NSPS that became effective in 1978.

The NSPS of 1978

Revisions implemented in 1978 were conceived, in part, to counter the relocation of U.S. coal production. The 1978 standards, which remain in effect and govern all power plants now being planned, were purposefully designed to make high-sulfur coal as economically attractive to utilities as low-sulfur coal. To accomplish this, the revisions stipulated not only that the old mass emissions limit (a "ceiling") must be met, but also that a fixed percentage of all sulfur dioxide be removed from all power plants burning coal. In recognition of the sulfur-content variations in coal, the revised NSPS permitted a sliding scale for emissions removal, to range between 70 and 90 percent, depending essentially on the sulfur content of coal used.

The effect of the provisions under the 1978 NSPS, which are quite rigid compared to the older standards, is to make the use of flue gas desulfurization technology--called "scrubbers"--mandatory. To date, scrubbers are the primary control technique that is commercially available to help utilities meet the NSPS in conventional boilers. No matter what coal is to be used, all new plants subject to the 1978 standards must be equipped with scrubbers or some other suitable control method. The costs of desulfurization will be the single most important element in the utilities' future costs for air pollution control.

THE COSTS OF EMISSIONS CONTROL

The utilities have already invested sizable sums of money to curb pollutant emissions, and they are likely to continue to do so. In each year since 1973, the industry devoted from 5 to 7 percent of all capital expenditures to emissions control hardware. Over the coming two decades (the base period for the Congressional Budget Office's projections), investment in air pollution control equipment is projected to involve 20 percent, or $33.4 billion (in 1980 dollars) of the roughly $167 billion needed to construct new coal-fired generating capacity (not including transmission and distribution).

The utilities' annual air pollution control costs, including operation of scrubbers, fixed capital charges, and premiums on low-sulfur fuel, are expected to rise from $5.35 billion in 1980 to $14.1 billion in the year 2000. By that year, these costs translate to a nationwide average of 3.43 mills per kilowatt-hour, representing roughly 6 percent of the average electricity charge to residential consumers in 1980. Pollution control at new units--by definition, subject to the 1978 NSPS--is expected to cost approximately 6 mills per kilowatt-hour for western power plants, which can use locally mined low-sulfur coal and lower-cost scrubbing methods, and 10 mills per kilowatt-hour for eastern facilities, which typically will use local high-sulfur coal and expensive scrubbing methods, or will ship low-sulfur coal from other regions to lower scrubbing costs.

Effects on The Utilities' Financial Condition

Because of the high capital costs of air pollution control, it is reasonable to question whether the Clean Air Act is placing an unmanageable burden on the electric utilities. Would the industry's finances be stronger if there were no need to invest in pollution control measures? The findings of the CBO analysis indicate that, though controlling emissions is indeed costly, it has not played a major role in impairing the utilities' financial position, and is not likely to do so in the future. A comparison of the bond ratings of two sample groups of firms with appreciable investments in pollution control against the industry as a whole suggests that utilities with commitments to pollution control tend to fare no better and no worse than all electric utilities in general. Special tax provisions and other mitigating factors directed at easing the investment costs of pollution control may account in part for why the costs of emissions control are not especially detrimental. Overall, most utilities, regardless of investment in emissions control, have experienced some financial decline (indicated by downgraded bond ratings), but this pattern may be more properly ascribed to other causes.

State-Mandated Accounting Methods. Accounting methods required by the states' regulatory public utility commissions often tend to make capital investments in new facilities burdensome. In most states, an electric utility cannot incorporate the costs of a new power plant in its rate bases until the facility becomes operational; hence, the utility cannot receive a return on its investment for roughly eight to 12 years, the usual construction period for power plants. On the other hand, rising fuel costs often may be recovered immediately from consumers, with the result that continued operation of older power plants burning oil or gas, though commonly more expensive, is the preferred alternative to investing in scrubber-equipped new facilities entailing high capital expenses.

EFFECTS ON U.S. COAL MARKETS

The westward shift in coal production seen over the past decade cannot be directly linked to the Clean Air Act, although such a shift is certainly clear. In 1960, the producing states in the East accounted for 95 percent of total production. By 1970, the East's share had declined to 85 percent and, by 1979, to roughly 75 percent. By the year 2000, the West is projected to hold a full 66 percent share of the nation's total coal production. Regarding western coal shipments east, sulfur dioxide limitations of the NSPS have influenced this only partly, and despite the intent of the revised NSPS to counter this trend, western producers are projected to capture a still greater share of the total midwestern and eastern coal markets in the future. In 1979, western producers shipped some 22 million tons of coal east to utilities; by the year 2000, some 127 million tons of western coal, or 7 percent of the total 1.9 billion tons produced in that year, are expected to be shipped east.

The current NSPS appear to have little influence to bolster midwestern and eastern coal production against such growth in the West. Western coal production is rising for several intrinsic reasons. First, lower-cost mining methods predominate there. Second, with this initial cost advantage, western coal can be shipped long distances, and even in the face of high and rising rail shipment costs, it can often compete favorably with indigenous midwestern coal. Third, the West is slated for a sizable expansion of its coal-fired electrical capacity, which will raise local demand for western coal. Thus, the prospects for the current NSPS to reverse the coal market's westward shift in production appear slight.

ALTERNATIVE APPROACHES TO THE CURRENT NEW SOURCE PERFORMANCE STANDARDS FOR ELECTRIC UTILITIES

All four of the policy choices the CBO has examined would affect the act's current NSPS as they pertain to sulfur dioxide emissions. Three of the alternatives would follow the general approach of existing standards, in that they would apply only to new coal-fired power plants. The fourth would depart from established approaches in allowing old as well as new sources to participate in the control of emissions under the standards. After a brief description of the options (also displayed in the Summary Table), the following analysis focuses on three potential effects:

93-281 O - 82 - 3

SUMMARY TABLE. ALTERNATIVE SULFUR DIOXIDE EMISSIONS STANDARDS (Projected to year 2000; emissions limits in pounds per million BTUs of fuel consumed)

Options and Descriptions	Effects on Emissions
Current NSPS Sets a ceiling of 1.2 pounds and a floor of 0.6 pounds; 90 percent scrubbing required for emissions above floor, and 70 percent for those below floor a/	Total emissions growth limited to annual 21 million tons; new plant emissions total 1.6 million tons a year
Option I Sets a ceiling of 1.2 pounds	Total emissions growth limited to annual 22.8 million tons; new plant emissions total 4 million tons a year
Option II Sets a ceiling of 1.2 pounds and a floor of 0.8 pounds; 70 percent scrubbing required for emissions above floor a/	Total emissions growth limited to annual 22.1 million tons; new plant emissions total 2.8 million tons a year
Option III Sets a ceiling of 1.2 pounds and a floor of 0.6 pounds; 90 percent scrubbing required for emissions above floor a/	Total emissions growth limited to annual 21.9 million tons; new plant emissions total 2 million tons a year
Option IV Requires same total emissions control as under current NSPS; allows emissions trading between old and new sources to meet overall limit	Total emissions growth limited to annual 21 million tons; new plant emissions total 2.5 million tons a year

a/ Applies to new electricity sources only.

(continued)

SUMMARY TABLE. (Continued)

Cost Effectiveness Relative to 1971 NSPS	Capital and Operating Cost Effects	Coal Market Changes
$2,411 per ton of sulfur dioxide removed	Total capital outlays of $33.4 billion; annual operating costs $14.1 billion in year 2000	High midwestern and lower western production; 127 million tons western coal shipped east
Basis of Comparison	Total capital outlays of $14 billion; annual operating costs $9.8 billion in year 2000	High western and low midwestern coal production; 151 million tons western coal shipped east
$1,929 per ton of sulfur dioxide removed	Total capital outlays of $14.6 billion; annual operating costs $11.1 billion in year 2000	High western and low midwestern coal production; 164 million tons western coal shipped east
$3,400 per ton of sulfur dioxide removed	Total capital outlays of $17.1 billion; annual operating costs $12.8 billion in year 2000	High western and midwestern coal production; 145 million tons western coal shipped east
$550 per ton of sulfur dioxide removed	Total capital outlays of $14.7 billion; annual operating costs $10.8 billion in year 2000	High western and moderate midwestern coal production; 149 million tons western coal shipped east

SOURCE: Congressional Budget Office

- Emissions,
- The electric utilities' costs to meet the standards and the options' cost effectiveness, and
- Effects on U.S. coal markets.

In the analysis, no attempt is made to weigh costs against benefits. Though the costs of such governmental regulations as pollution control are reasonably amenable to being quantified and compared, the benefits are not. No generally acceptable measures exist for gauging health improvements, preservation of natural and structural assets, or other societal gains that may result from federal emissions limits. Thus, the CBO has not assessed measurable costs of abatement against important but intangible benefits.

Option I. Revert to the NSPS of 1971

Reenactment of the original NSPS would effectively rescind the present requirement that all new power plants be equipped with scrubbers. The only standard would be a mass emissions limit of 1.2 pounds of sulfur dioxide per million BTUs of fuel consumed; no fixed percentage of that pollutant would have to be removed. Thus, combustion of low-sulfur coal would offer an acceptable means of compliance.

Option II. Achieve 70 Percent Control of Sulfur Dioxide Emissions and Set a 0.8 Pound Floor

Following the general structure of the current NSPS, this option would require scrubbing for some plants but not all, depending on the coal used. Sulfur dioxide emissions, between a maximum permissible ceiling of 1.2 pounds and a floor of 0.8 pounds per million BTUs of fuel, would have to also be reduced by 70 percent. For emissions below the floor, no specific percentage reduction levels would be mandated. Thus, low-sulfur coal could be burnt with little or no scrubbing; high-sulfur coal would have to be scrubbed to remove at least 70 percent of sulfur dioxide emissions.

Option III. Achieve 90 Percent Control of Sulfur Dioxide Emissions and Set a 0.6 Pound Floor

A variant of Option II and the current standards, this alternative would stipulate the same sulfur dioxide emissions ceiling (1.2 pounds per million

BTUs) but would establish an emissions floor of 0.6 pounds. The percentage removal for emissions between the ceiling and floor would be 90 percent, while no control requirements would be specified for emissions below the floor. This option would thus retain the current scrubbing requirement for high-sulfur coal, reduce the amount necessary for low-sulfur coals, and eliminate it entirely for very low-sulfur coals.

Option IV. Constrain Total Emissions Growth by Balancing Sulfur Dioxide Emissions from Old and New Sources

This option, a fundamental departure from other approaches, would allow old as well as new sources to be involved in meeting emissions standards. While still directed at new sources, the standards would permit a new facility to trade emissions with other existing power plants to achieve the same quantity of emissions control as required under the present NSPS. Within a given area--in this example, a state--a planned plant would be allowed to find a trading partner among existing sources. If the old source could meet standards sufficiently below its applicable regulations, its new source trading partner could exceed the limit by an equal amount, so long as the old source continued to operate. This approach is termed new source "bubbling", since it allows control to be balanced between all emissions within a given atmospheric area, so long as the total quantity leaving the bubble remains constant. Acceptable methods of compliance would involve both scrubbing and low-sulfur fuels at both old and new power plants.

Effects of the Alternatives on Future Emissions

In contrast to the current NSPS, which would hold the growth of sulfur dioxide emissions from electric utilities to a total of 20 percent over the coming two decades, Option I would allow emissions to rise by 30 percent. This translates into 21 million tons under current law and 22.8 million tons under Option I. These figures represent the upper and lower bounds of emissions control achievable under all the options. Inasmuch as old sources are projected to account for some 80 percent of all sulfur dioxide emissions through the year 2000, there is little room for improvement to be achieved over the projection period by regulations governing new sources only. Similarly, Option IV, while reducing the costs of emissions control and spreading the burden between new and old sources, cannot be expected to bring about any radical change in overall emissions levels, since the control levels are based on current NSPS. New power plants constructed subject to Option I would emit roughly twice the amount of sulfur dioxide as those constructed under the current standards. These differences in total

emissions would become measurable only when the older generation of dirtier facilities retire, sometime around the year 2010.

Cost Effect on Utilities

Although the CBO analysis suggests that capital costs for air pollution control may not be detrimental to the utilities' financial condition, the high capital expense of scrubbing does appear to raise overall costs for the utilities and the consumers. The current NSPS would require the greatest capital outlay ($33.4 billion) and would result in the highest annual cost ($14.1 billion by the year 2000). In contrast, Option I (the previous NSPS), which would allow widespread use of low-sulfur coal, would require only $14 billion in capital and $9.8 billion in annual costs by the year 2000. The other options, by promoting different mixes of scrubbing and low-sulfur coal combustion, fall somewhere in between, although the capital requirements of each of these options appear not to be nearly so high as the current standards.

Cost Effectiveness. A true measure of the cost differences between each option can only be made when differences in emissions are also taken into account. A rough gauge of cost effectiveness may be derived by measuring the costs of reducing sulfur dioxide emissions below the highest levels projected--in this case, the 22.8 million tons per year projected under Option I. The current NSPS would cost $2,411 for each ton of sulfur dioxide removed below that level. Option II would cost $1,929, and Option III--the most costly in these terms--$3,400 per ton removed. Option IV, in contrast, offers the prospect of lowering sulfur dioxide levels at a cost of only $550 per ton removed for as long as existing old sources remain in operation; the reason for this potential economy is the ability to achieve low-cost emissions reductions at existing facilities by relying on lower-sulfur fuels. For example, converting a 500-megawatt plant from high- to low-sulfur coal would cost $431 for each ton of sulfur dioxide removed from previous emissions levels; such reductions might be used in a trade. Costs for a new plant, in contrast, might total some $1,230 per ton to achieve similar levels of reduction below the 1.2 pounds sulfur dioxide emissions limit of Option I.

Coal Market Effects

From the standpoint of the U.S. coal market, any emissions standards that would place heavy emphasis on the use of scrubbers should discourage the purchase of nonlocal coal to meet emissions standards. Conversely, de-emphasizing control technology in favor of mass emissions limits should