

EXECUTIVE SUMMARY  
AN ANALYSIS OF ALTERNATIVE  
POLICIES FOR ATTAINING AND  
MAINTAINING A SHORT-TERM  
NO<sub>2</sub> STANDARD

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## EXECUTIVE SUMMARY

### 1. Introduction

This report summarizes the results of an analysis of alternative policies for implementing short-term NO<sub>2</sub> standards like those currently under consideration by EPA. Policy alternatives considered include an extension of current regulatory approaches to provide for control of stationary source emissions in state implementation plans, adoption of an emissions charge as a substitute for emissions limitation regulations, and adoption of a marketable permit program as a substitute for emissions limitation regulations.

Our analysis shows that the latter two alternatives (emissions charges and marketable permits) would, if appropriately designed, meet and maintain ambient standards at lower cost than would a regulatory approach. It also shows that while the practical problems of implementing a policy based upon economic incentives are not to be minimized, neither are they insurmountable. Both emissions charges and marketable emissions permits could be implemented using only currently available legal and administrative "technology". The cost savings potentially realizable to virtually all sectors of society from a policy based on economic incentives provide an enormous incentive to deal with the practical problems that would arise.

Another important finding of our analysis is that structuring policies to take account of differences between sources -- on a source-by-source basis -- will result in a substantial saving of resources required to attain

ambient standards. This is true regardless of whether the control policy chosen is based on economic incentives or upon regulation. However, as will also be shown, the savings tend to be greatest under economic incentives policies. For this reason, we conclude that incentive policies are the best policy approach.

In addition to comparing economic approaches to regulatory ones, we also compare economic approaches based on emissions charges to economic approaches based on marketable permits. Our analysis shows that while both of the economic policy approaches would result in low cost attainment and maintenance of short-term  $\text{NO}_2$  standards, the policy-administering authority would need to take much less initiative in acquiring detailed information about individual sources under a marketable permit system than under an emissions charge system. Also, marketable permit systems would be similar administratively to the permit systems now being administered by many state and local air pollution control agencies. For these reasons, we conclude that marketable emissions permits may offer the best economic policy instrument for implementing stationary source  $\text{NO}_x$  control.

It is important to qualify these conclusions by noting that we limit the scope of our investigation in several ways. The most important of these are the following:

- No systematic quantitative evaluation of the effects of uncertainty on the cost and effectiveness of alternative policies is made. However, a qualitative analysis shows that uncertainty tends to favor economic incentives approaches.
- No formal analysis is conducted of the effects of growth and technical change on optimal incentive structures. In our formal analysis, we limit ourselves to analysis of the effects of policy

alternatives on annual cost in a single year and ambient concentrations in a single year. In our quantitative calculations, we use existing emission inventory data for stationary sources, without adjustment for growth in stationary sources.

- No consideration is given to incentives that vary by time of day, or in some other seasonal fashion. However, under current technology, virtually all of control costs are fixed. Our calculations thus probably would be little different were we to consider these alternatives.

While the importance of these and other limitations in our study is not to be minimized, and while each should be addressed in further studies, we believe that the nature of our conclusions would not be materially affected by these additional investigations. On the basis of our conclusions, we recommend that serious consideration be given to implementing an economic incentive policy for air pollution control.

## 2. Conclusions

Our major conclusions are as follows.

ATTAINMENT AND MAINTENANCE OF A SHORT-TERM  
NO<sub>2</sub> STANDARD OF 250  $\mu\text{g}/\text{m}^3$  POSES A SERIOUS PROBLEM.

ATTAINMENT AND MAINTENANCE OF A SHORT-TERM  
NO<sub>2</sub> STANDARD OF 500  $\mu\text{g}/\text{m}^3$  DOES NOT APPEAR TO  
POSE A PROBLEM.

Studies show that 202 AQCR's may have one hour concentrations of NO<sub>2</sub> in excess of 250  $\mu\text{g}/\text{m}^3$ . That is, approximately four out of five AQCR's may be in non-attainment status.

At a standard of 500  $\mu\text{g}/\text{m}^3$ , very few regions would be in non-attainment status, and the cost of bringing these regions into attainment status would be low. Under these circumstances, consideration of

alternatives to current regulatory approaches to pollution control for implementing a short-term NO<sub>2</sub> standard would be unwarranted due to the costs of policy change. Accordingly, the balance of our conclusions are predicated on the condition that a short-term standard is set that is sufficiently low to place a number of regions in non-attainment status and that the costs of attainment in these regions are significant.

APPLICATION OF CURRENTLY AVAILABLE EMISSIONS CONTROL TECHNOLOGY WILL NOT SUFFICE TO ATTAIN AN AMBIENT STANDARD OF 250  $\mu\text{g}/\text{m}^3$  IN MANY AQCR'S. APPLICATION OF STATIONARY SOURCE CONTROLS PROJECTED TO BE AVAILABLE IN THE EARLY TO MID-1980'S WILL BE REQUIRED.

Our data show that between 66 and 84 AQCR's would not attain a 250  $\mu\text{g}/\text{m}^3$  standard by 1982, and that between 26 and 50 would not have attained this level by 1990 using currently available emission controls in conjunction with the emission controls to be applied to mobile source emissions. This clearly points to the need to develop more effective emission control technology for stationary source emissions of NO<sub>x</sub>.

ADEQUATE TECHNOLOGY FOR CONTINUOUS MONITORING OF NO<sub>x</sub> EMISSIONS IS CURRENTLY AVAILABLE AND THE COST OF THIS TECHNOLOGY (EXPRESSED ON AN ANNUAL BASIS) IS LESS THAN 25 PERCENT OF THE ANNUAL COST OF EMISSIONS CONTROL PROJECTED TO BE REQUIRED TO MEET SHORT-TERM STANDARDS.

We see no barriers to either regulation or pricing of emissions of stationary source NO<sub>x</sub> emissions. Adequate technology is currently available, and the cost of this technology is not large in relation to the control outlays that will be required to meet stringent short-term standards. We believe that the cost of continuous monitoring certainly

will be less than 25 percent of control costs, and more likely on the order of 5 to 10 percent of these costs.

EMISSIONS CONTROL STRATEGIES THAT TAKE ACCOUNT OF DIFFERENCES IN SOURCES' INCREMENTAL COSTS OF CONTROL AND INCREMENTAL CONTRIBUTIONS TO AMBIENT CONCENTRATIONS CAN ACHIEVE SHORT-TERM AMBIENT STANDARDS AT SIGNIFICANTLY LOWER TOTAL COST THAN CAN STRATEGIES WHICH DO NOT TAKE ACCOUNT OF THESE DIFFERENCES.

Our quantitative analysis of emissions control strategies in Chicago shows that a least cost strategy (which is designed to take account of cost and ambient contribution differences) is about one-fourth as costly as a strategy which reflects what might be achieved under today's sophisticated regulatory implementation planning methods, and only about one-tenth as costly as the strategy that reflects today's crudest regulatory implementation planning methods. In absolute terms, we conclude that a policy which would lead to adoption of something approximating a least cost strategy would save on the order of \$70 million per year in the Chicago Air Quality Control Region.

EMISSIONS CHARGES AND/OR MARKETABLE PERMITS ARE EFFECTIVE POLICY INSTRUMENTS FOR IMPLEMENTING ATTAINMENT AND MAINTENANCE OF AMBIENT STANDARDS.

Our qualitative analysis shows that emissions charges and/or marketable permits will provide profit-and-loss incentives to firms to implement the degree of emissions control required to attain ambient standards. We also show that the conclusion that charges and permits are effective holds for a wide variety of assumptions about the degree of market power of sources and their organizational form. We thus have

every reason to believe that charge systems and permit systems would work to implement attainment and maintenance of a short-term NO<sub>2</sub> ambient standard.

Most importantly, our qualitative analysis shows that emissions charges and/or marketable permits are more efficient and effective than regulatory policies (even optimal ones) in the face of uncertainty. The practical strength of incentive-based approaches to pollution control is that they tend to divide the responsibility for decision-making along roughly the same lines that detailed knowledge about the various parameters relevant to cost-effective control is divided. The result is that economic policies may be expected to result in lower costs of pollution abatement.

EMISSIONS CHARGES AND/OR MARKETABLE PERMITS  
ARE AN EFFICIENT POLICY INSTRUMENT FOR  
IMPLEMENTING ATTAINMENT AND MAINTENANCE OF  
AMBIENT STANDARDS IF THEY ARE STRUCTURED TO  
TAKE ACCOUNT OF DIFFERENCES BETWEEN SOURCES  
IN INCREMENTAL CONTRIBUTIONS TO AMBIENT  
CONCENTRATIONS.

Our analyses show that this conclusion is supported both on theoretical and empirical grounds. Perhaps our most surprising finding is just how inefficient a charge or permit system can be if it is not structured to take account of contribution differences. In our analysis of the incentive approaches to air pollution control, we show that charge and permit systems which do not recognize these differences induce the adoption of control strategies that are markedly more costly than those which do. This result points to the conclusion that it is important, in structuring an incentive system, to come as close to setting incentives on a source-by-source basis, on the basis of contributions to ambient concentrations, as is possible. There are potentially enormous gains from doing so.

It does not follow, if practical considerations prohibit such fine distinctions between sources, that the case for an incentives based policy as an alternative to a regulatory one becomes any weaker. These same practical considerations will also constrain the extent to which regulations can be set in a manner to capitalize on differences between sources.

The telling advantage of policy based on economic incentives is that it performs better under the pervasive uncertainty which surrounds the implementation of all pollution control policies. As long as the practical considerations that constrain policy are roughly similar, or pose less severe constraints on incentives as we have argued, the superior performance of economic incentives under uncertainty tips the economic case strongly in their favor. The superior performance of incentives in inducing the development and application of emissions control technology provides still another economic argument in their favor.

EFFICIENT EMISSIONS CHARGES AND/OR MARKETABLE PERMITS SYSTEMS IMPOSE A SMALLER ABSOLUTE BURDEN (AS MEASURED BY THE SUM OF EMISSION CONTROL COSTS PLUS CHARGE/PERMIT PAYMENTS) ON ALMOST ALL SOURCES THAN DOES ANY OTHER POLICY INSTRUMENT WE EXAMINE,

This conclusion is based on our qualitative analyses of alternative policies and our quantitative analysis of Chicago data. By "efficient" system, we mean one which takes account of sources' contributions to ambient concentrations. Our results show that only 94 of 797 sources have to control to meet ambient standards under an efficient charges or permits program, as compared with 742 of 797 sources under an assumed likely regulatory baseline. Total control costs plus charge/permit payments are about \$25 million per year under efficient charges/permits

systems, as against a total annual outlay of approximately \$94 million under the lowest cost assumed regulatory baseline we have examined.

In reaching the conclusion that a well-structured incentive system places a smaller economic burden on society than does regulation, we also explicitly consider the possibility that regulation could be improved to incorporate cost and effectiveness tradeoffs into the regulation-making procedure. We call this brand of regulation “enlightened regulation”.

In our qualitative analyses, we show that, due to imperfections in information, and due to differences in the amount and quality of knowledge possessed by the different “actors” involved in air pollution control decisions, “enlightened regulation” would tend to have higher costs than would a well-designed incentive system,

EFFICIENT CHARGES AND/OR MARKETABLE PERMITS REQUIRE THAT CHARGE LEVELS AND PERMIT PRICES VARY FROM SOURCE TO SOURCE. WHILE THE RESULTING CHARGE/PRICE LEVELS MAY VARY WIDELY, THEY MAY BE READILY EXPLAINABLE IN TERMS OF FACTORS RELATED TO CONTRIBUTIONS TO AMBIENT CONCENTRATIONS.

Our theoretical analysis establishes that efficient charge levels and permit prices generally vary from source to source. Our quantitative analysis shows that in the case of Chicago, the highest charge/price is about 700 times as large as the lowest charge/price among those sources implementing emissions controls. However, we also see that virtually 100 percent of the variation in charge levels is explained in terms of factors that probably correlate with incremental contributions to ambient pollution levels. While we believe that these “explanations”, coupled with the fact that so many sources benefit by adoption of an efficient incentives program should be convincing, we also demonstrate that efficient incentives

can be structured so as to eliminate or reduce the variation in charge levels/permit prices. The potential savings of efficient approaches are so large, as we have concluded above, that all parties can be given incentives to find ways to implement an efficient policy.

THERE ARE NO LEGAL BARRIERS TO THE LEGISLATION  
AND IMPLEMENTATION OF EITHER CHARGES OR A  
MARKETABLE PERMITS PROGRAM.

The analyses we examine conclude that programs can be enacted within the legitimate constitutional powers of the government and can be implemented effectively in a manner consistent with legal constraints on the exercise of government power. However, existing legislation may need to be amended explicitly to allow the implementation of such systems.

THE COSTS OF PUBLIC ADMINISTRATION OF EITHER  
A CHARGES OR MARKETABLE PERMITS PROGRAM  
WOULD BE EQUAL TO OR LESS THAN THOSE  
ASSOCIATED WITH THE USE OF AN EFFECTIVE  
REGULATORY APPROACH LIKE THAT CURRENTLY  
PRACTICED.

Our analysis shows that the incremental cost of administering, monitoring, and enforcing the control of stationary source emissions of  $\text{NO}_x$  will not be great in relation to the costs of emissions control under either regulation or an incentive-based approach. We do find, however, that these administrative costs are likely to be of approximately the same magnitude (or perhaps slightly lower) under either a charges or marketable permits program as they are under a regulatory program. The main reason for this is that effective regulation is projected to involve more investigation, negotiation, and litigation than would an equally effective incentive system.

A MARKETABLE PERMIT SYSTEM IS PREFERABLE TO A CHARGE SYSTEM FOR IMPLEMENTING ATTAINMENT AND MAINTENANCE OF THE SHORT-TERM NO<sub>2</sub> STANDARD.

We base this conclusion on the following findings of our comparative analyses of these two economic policies:

- 1) To implement an efficient charge system, the charge administering agency must take the initiative to acquire information about sources' control costs. This is a difficult and expensive undertaking if costs are to be determined accurately. Under a permit system, the agency does not need to take the initiative to acquire detailed source-by-source cost data. These data are revealed by sources as they buy and sell permits from one another,
- 2) A marketable permit system self-adjusts to inflation and growth. A charges system requires that the agency make adjustments to these factors, adjustments which depend upon uncertain and perhaps expensive data.
- 3) A marketable permit system can be made self-enforcing by providing for automatic surcharges on emissions in excess of those for which permits are held.
- 4) It is relatively easy to incorporate "equal treatment" considerations into the design of a permit system without affecting its efficiency,
- 5) A marketable permit system is administratively and legally similar to permit programs now operated under regulatory control programs. This means that it would be administered alongside of existing regulatory programs for other pollutants more easily than could a charge system. A marketable permit system is also close in spirit to the Offset Policy currently in force.

A MARKETABLE PERMIT SYSTEM IS A PRACTICAL ALTERNATIVE TO DIRECT REGULATION WHICH MAY ACHIEVE AMBIENT STANDARDS AT SIGNIFICANTLY LOWER TOTAL COST THAN WOULD DIRECT REGULATION. WE BELIEVE IT SHOULD BE GIVEN SERIOUS CONSIDERATION.

The potential gains from implementing pollution control through this type of policy instrument are great enough to warrant that the approach be given serious consideration. The design of a marketable permit program that we present in our study provides a fairly advanced starting point for a marketable permit option to air pollution control. There are, however, a number of details that need to be worked out. How, for example, would bids and offers to sell be communicated to the market-maker? How would data be processed and disseminated to the various market participants? Will strategic behavior be a problem, and if so, how will it be dealt with? Will monopolies of permits tend to arise? How can monopolies of permits be prosecuted under laws governing restraint of trade? What is the most suitable algorithm for matching orders? Who will do the accounting? What technical assistance would be provided to the states in starting and running a marketable permits program? These are detailed practical problems that will have to be worked out before a marketable permit system can be implemented.

