Barriers to Implementing Tradable Air Pollution Permits: Problems of Regulatory Interactions*

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Since 1977, the Environmental Protection Agency (EPA) has been developing and implementing an increasingly comprehensive system of "controlled trading options" for air pollution control.[1] These programs introduce a limited market for the allocation of emissions among sources of air pollution. Starting with existing source-specific standards[2] as a baseline, policies such as bubbles,[3] emissions banks,[4] netting[5] and offsets[6] allow

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1. Controlled trading options are the methods that have been developed at EPA to allow substitution of emissions between sources. A definition and explanation of the concept is contained in OFFICE OF PLANNING & MGMT., U.S. EPA, SMARTER REGULATION (1981) [hereinafter cited as SMARTER REGULATION]. For a legal analysis of how this program is related to controlling legislation, see Landau, *Who Owns the Air? The Emissions Offset Concept and Its Implementation,* 9 ENVTL. L. 575 (1979).

2. The principal method of controlling emissions into the atmosphere is to set one of two types of technical standards: an input standard, which requires that a specific abatement method be adopted, or an output standard, which sets a limit on the rate at which a pollutant can be emitted from a source. Separate standards are usually written for each orifice through which pollutants may be emitted, so that a given factory may have a very large number of standards that apply to it. Controlled trading options apply to trades of emissions among sources for which standards have already been written. *See* SMARTER REGULATION, *supra* note 1, at 3-5. For an analysis of how the standard-setting process works, see Noll, *The Feasibility of Tradable Emissions Permits in the United States,* in PUBLIC SECTOR ECONOMICS. (J. Finsinger, ed. 1983).

3. A bubble is a situation in which the owners of a plant may increase emissions from one source if they make a corresponding decrease in emissions from another source at the same plant. *See* SMARTER REGULATION, *supra* note 1, at 6.

4. An emissions bank is a procedure whereby emissions at a source are reduced below the applicable standard and the source owner is given a credit for the emissions reduction that can later be sold to another firm to allow it to increase its emissions. The regulatory authority acts as a kind of bank, taking "deposits" of emissions credits which can later be "withdrawals" by a new or expanding plant. *See id.* at 8.

5. Netting is the process by which an expanded or remodeled plant in a Prevention of Significant Deterioration (PSD) region can escape an otherwise required new source review if the change in the facility does not cause a significant net increase in emissions. This amounts to using the bubble concept to cover cases in which new sources are added to a plant, but the total amount of emissions does not change significantly. *See* Palmisano, Have Markets for Trading Emission Reduction Credits Failed or Succeeded? 7 (1982) (Office of Policy & Resource Mgmt. Working Paper No. 2, U.S. EPA).

firms to negotiate — within limits — trades of emissions permits in a manner that satisfies air quality standards at lower total costs. These trades, once agreed upon by the parties, in most cases must then be proposed to regulators as amendments to the existing set of source-specific standards.[7]

EPA's controlled trading policy places constraints on the amount of emissions from sources before and after a trade is consummated. For example, new sources must satisfy new source performance standards in any case, and can use trades only to acquire permits for the emissions released if these standards are satisfied.[8] A logical next step in reforming air pollution regulation is to adopt a more comprehensive marketable permits system by eliminating the requirements that trades be reviewed on a case-by-case basis by regulators, that a source be in compliance with standards prior to trading, and that new facilities remain in compliance with new source performance standards. Regulators adopting this form of tradable emissions permits would no longer set source-specific technical standards as a baseline for further trades. Instead, the tasks facing the regulator would be to set overall ambient air quality standards, to limit total emissions in each geographic region to an amount that satisfies these standards, to organize the market institutions for allocating emissions among sources, and then to enforce the overall standards by detecting and fining sources that emit more pollutants than their permits allow.

In this paper we will not attempt a comprehensive analysis of the workability of an efficient market in tradable emissions permits. Our purpose is to explore the narrower topic of how the political feasibility and economic efficiency of tradable permits are affected by the status quo ante of the regulatory environment and by the way in which permits markets are designed.

Our analysis of political feasibility is not exhaustive. It focuses on two groups that are likely to play important roles in the debate about reform of environmental regulation: (1) industrial sources of emissions and (2) regulators, especially energy regulatory officials. Our hypothesis, discussed more fully in the next section of the paper, is that the probability that a market for emissions permits will be adopted is significantly affected by

6. Offsets are direct sales of emissions permits between companies. *See* SMARTER REGULATION, *supra* note 1, at 7. *See also infra* note 18 and accompanying text.

7. For a description of the procedures for integrating permit trades into a state's set of standards for achieving air quality objectives, see ICF, INC., EMISSIONS REDUCTION BANKING MANUAL (1981) (U.S. EPA Emission Reduction Banking and Trading Publication BG200, Washington, D.C.). For a more thorough analysis of the process for implementing controlled trading options, see Hahn & Noll, *Implementing Tradable Emissions Permits*, in REFORMING SOCIAL REGULATION (L. Gramer & F. Thompson eds. 1982).

8. Revised EPA Emission Offset Interpretive Ruling, 44 Fed. Reg. 3274 (1979).

the positions of these two groups. For industrial sources, we assume that the primary factor affecting their stand on this type of reform will be its economic impact on them, with the vigor of their participation correlated to the size of their financial stakes in the outcome.[9] With respect to regulators of the energy sector, their support or opposition is assumed to be determined by the extent to which a tradable emissions permits system is regarded as facilitating or inhibiting their objectives in energy regulation. Other groups, of course, will play a role in the debate over any reform of environmental policy, including the general public, environmental organizations, producers of abatement equipment, energy companies, and consumers of polluting products. A complete analysis of the politics of regulatory reform would have to take into account the likely influence of these groups and how various types of reform would affect their participation in the policy process.

Before examining the issue of political feasibility, we will briefly summarize the principal attractions and potential problems of a market for emissions permits. A system of environmental regulation that places relatively few constraints on trades of emissions permits has a number of important theoretical advantages.[10] First, assuming that businesses seek to minimize costs, a competitive market for permits achieves a given emissions target at minimum total cost. By contrast, environmental regulators are unlikely to possess sufficiently precise information about abatement technologies to find the minimum-cost strategy for achieving their environmental objectives. Moreover, the separation of authority over different types of sources among federal, state, and local regulators is a barrier to finding efficient trade-offs of emissions between sources that are regulated by different governmental entities.

A second theoretical advantage of tradable permits is that they ease both the adoption of new abatement technology and the entry and exit of pollution sources. With source-specific regulation, every new abatement technology and every new source must obtain specific regulatory approval.[11] This requirement imposes costs of delay and process that not only inhibit the adoption of more efficient abatement technologies, but also restrict structural change in the economy by making new production facilities less attractive to investors. By contrast, a tradable permits system

9. Theories of the regulatory process typically emphasize the role of narrow economic self-interest in motivating participation in the regulatory process and influencing policy outcomes. *See* M. BERNSTEIN, REGULATING BUSINESS BY INDEPENDENT COMMISSION (1955) R. NOLL, REFORMING REGULATION (1971); Stigler, *The Theory of Economic Regulation,* 2 BELL J. ECON. & MGMT. SCI. 3 (1971).

10. For an interesting and thorough discussion of this approach, see J. DALES, POLLUTION, PROPERTY AND PRICES (1968).

11. For a detailed analysis of the process of standard setting in air pollution regulation, see Pedersen, *Why the Clean Air Act Works Badly,* 129 U. PA. L. REV. 1059 (1981).

makes emissions more like other inputs to a production process in that emissions permits, like other inputs, must be acquired through a market. To the extent that a permits market is "thick" — that is, characterized by easily arranged transactions at predictable prices — the problem of acquiring new permits (or selling old ones) would not differ materially from the problems of participating in markets for labor, raw materials, land, or other inputs.[12]

The third advantage of tradable permits is that they avoid some of the costs of the regulatory process itself. Regulators would not need to devote resources to identifying specific technical fixes for a long list of emissions sources and to undertaking a protracted procedure for changing standards for any particular source. Regulated firms would not need to incur the costs of defending their positions in these same proceedings.

The practical availability of these theoretical advantages depends on whether a market for emissions permits is feasible in both the legal and economic senses. Among the questions of legal feasibility are issues pertaining to the establishment of an emissions baseline from which trades can be made and to the choice of methods for monitoring and enforcing the permits. The questions of economic feasibility center on whether an efficient market is viable. A competitive market requires a sufficiently large number of buyers and sellers so that no buyer or seller has a large enough share of the market to extract from it significant monopsony or monopoly profits. Consequently, the feasibility of a permits market is in part an empirical issue that turns on the number, geographic distribution, and abatement cost functions of the sources of pollution in a region, on the technical relationship between emissions and pollution, and on the specific legal and institutional features of the permits market.[13] We have examined these issues for a specific pollutant in a specific airshed — atmo-

12. A thick market is one in which trades are frequent and trading partners are easy to find so that a person wishing to make a trade can easily estimate the price and find a trading partner. Thus, the market has relatively few uncertainties and relatively low transactions costs. For a discussion of the problem of market thickness in implementing tradable emissions permits, see Hahn & Noll, *Designing a Market for Tradable Emissions Permits*, in REFORM OF ENVIRONMENTAL REGULATION 137 (W. Magat ed. 1982).

13. Each of the factors mentioned here affects the structure of the permits market. Profit-maximizing firms will seek to minimize the sum of abatement costs and the market value of permit holdings. Hence, abatement costs enter into the calculation by each polluting company of its demand for permits. The emissions from each source then undergo complicated chemical reactions and, depending on meteorological conditions and the geography of the region, combine with emissions from other sources to produce a pattern of pollution. The technical features of the process determine the definition of a region in which regulators can rationally establish an overall ceiling on emissions and in which permits can be traded through a market without producing a change in overall air quality. For a detailed exposition of how these technical matters affect the definition and structure of a permits market, see Montgomery, *Markets in Licenses and Efficient Pollution Control Programs*, 5 J. ECON. THEORY 395 (1972).

spheric sulfate particulates in Los Angeles — and have concluded that an efficient permits market can be designed to solve that particular problem.[14]

Unfortunately, legal and economic feasibility is not the only issue to be resolved. The implementation of tradable emissions permits is further complicated by other regulatory programs. Specifically, current environmental and energy regulation affects the expected performance of a permits market and the attitudes of regulated firms, regulators, environmentalists, and the general public about making emissions permits tradable.

This paper examines the interactions between tradable emissions and three current regulatory policies, each of which affects the political feasibility of a permits market. The first of these policies is the present method of regulating emissions from stationary sources, which grants polluting firms an implicit property right in the emissions permitted. In effect, part of the wealth of existing polluters is in the form of permits to operate according to established source-specific standards. These same firms would participate in a permits market. A tradable permits program can threaten existing wealth positions, depending on the procedures adopted for dealing with established permits. How these wealth positions would be altered, if at all, by a permits market affects the desirability of this reform to firms that are in compliance with current standards, and hence their political resistance to the reform. This can severely limit the range of politically feasible market institutions for implementing tradable permits, a problem addressed in the next section.

The second regulatory interaction examined here is the relationship of environmental policy to natural gas regulation. Nearly all man-made air pollution is caused by processing and burning hydrocarbon fuels.[15] Consequently, policies that affect the price and availability of fuels will also affect the cost of attaining environmental policy goals. Section II of this paper examines the relationship between a tradable permits program for dealing with sulfate particulates in Los Angeles and the status of natural gas regulation. The principal findings reported in Section II are that the price and availability of natural gas are the most important factors influencing the cost of abating sulfur oxides emissions in Los Angeles, and constitute the greatest source of uncertainty in environmental policy in that region.

The third instance of regulatory interaction to be analyzed is the effect

14. G. CASS, R. HAHN & R. NOLL, IMPLEMENTING TRADABLE EMISSIONS PERMITS FOR SULFUR OXIDES EMISSIONS IN THE SOUTH COAST AIR BASIN: FINAL REPORT TO THE CALIFORNIA AIR RESOURCES BOARD (June 30, 1982).

15. For a list of the major air pollutants and their primary sources, see W. BAUMOL & W. OATES, ECONOMICS, ENVIRONMENTAL POLICY, AND THE QUALITY OF LIFE 45-47 (1979).

of public utility regulation on the performance of a market for emissions permits. Approximately half of the sulfur oxides emissions in Los Angeles, and a larger proportion in some other regions, emanates from electric power generation facilities.[16] Electric utilities are heavily regulated by public utility commissions, which control prices and profits by determining the amount of utility costs that can be recovered from ratepayers. Whether an electric utility will respond to an incentive-based regulatory reform like tradable emissions permits in a manner that achieves pollution abatement at minimum cost depends upon the treatment of various environmental costs and incentive methods by public utility regulators. This topic is examined in Section III.

Because institutional problems are man-made, they pose no insurmountable barrier, in principle, to the implementation of tradable emissions permits. Nevertheless, they illustrate that reform of one domain of regulation can easily be frustrated by other regulatory policies, and that the feasibility of effective reform depends on dealing simultaneously with all regulatory policies that significantly affect polluting activities, directly or indirectly.

I. Existing Source-Specific Standards as a Constraint on Reform

One of EPA's controlled trading options is the offset policy. It arose in response to a dilemma facing regions that are not in compliance with ambient air quality standards. In these regions, no net addition to emissions can be created.[17] If this were to lead to a zero emissions standard for new or expanding sources, it would essentially preclude any economic expansion as well as any possibility for competitive entry. To avoid this outcome, environmental regulators developed the offset policy, a procedure whereby new and expanding sources of pollution could satisfy the zero-emissions requirement by abating pollution elsewhere in the region, rather than by constructing a facility that actually produced no emissions.[18] Under the offset policy, a new or expanding source negotiates with an old source that is in compliance with its standards. The purpose of this bargaining is to reach an agreement whereby the new or expanding source pays the old source a mutually acceptable amount in return for the latter

16. G. CASS, METHODS FOR SULFATE AIR QUALITY MANAGEMENT WITH APPLICATIONS TO LOS ANGELES 195 (1974) (Environmental Quality Laboratory, California Institute of Technology). *See also* NATIONAL RESEARCH COUNCIL, AIR QUALITY AND STATIONARY SOURCE EMISSION CONTROL, S. DOC. NO. 4, 94th Cong., 1st Sess. (1975).

17. NATIONAL COMM'N ON AIR QUALITY, TO BREATHE CLEAN AIR, pt. 3, ch. 4 (1981), describes the policy developed for nonattainment areas by EPA pursuant to the 1977 amendments to the Clean Air Act. Amendments of 1977, Pub. L. No. 95-95, 91 Stat. 685 (codified in scattered sections of 42 U.S.C.).

18. Revised EPA Emission Offset Interpretive Ruling, 44 Fed. Reg. 3274 (1979).

reducing its emissions by at least as much as the former will add to the regional emissions inventory.

The major constraint placed on new or expanding firms was the requirement that they satisfy applicable standards for new sources after the trade is consummated.[19] At minimum this can mean compliance with federal new source performance standards (NSPS). In regions that are not in compliance with federal ambient air quality standards (nonattainment areas), new sources are required to achieve the Lowest Achievable Emissions Rate (LAER). This is distinguished from the Best Available Control Technology (BACT), a requirement applied to new sources in regions that are in compliance with ambient air quality standards but that are designated as Prevention of Significant Deterioration (PSD) regions.[20] The distinctions among NSPS, LAER, and BACT, although of debatable practical significance,[21] were intended to establish a commitment to develop a policy for nonattainment areas that would not allow firms to reduce emissions from old sources as a means of satisfying the zero-emissions limit until every available technical control had been applied to the new facility.[22] As a political matter, the LAER requirement assured environmentalists that offsets would not cause a significant relaxation of emissions limits or retard progress toward achieving air quality objectives.

Another controlled trading option is the bubble policy. Regulators normally set standards for each point at a facility where emissions escape;

19. For a detailed explanation of how the offset policy works, see del Calvoy Gonzalez, *Markets in Air: Problems and Prospects of Controlled Trading*, 5 HARV. ENVTL. L. REV. 377 (1981).

20. New Source Performance Standards (NSPS) are federal standards, set by either Congress or EPA, that establish a nationwide minimum requirement for categories of sources that are deemed to be important causes of hazardous pollutants. In adopting NSPS, EPA can take account of costs and energy policy considerations, and need not require the state of the art in abatement technology. In addition, states are required to adopt BACT standards on a case-by-case basis for major new sources in PSD areas. In the development of a BACT standard, questions of economic and technical feasibility as well as the contribution of the new source to ambient air quality, given geographic and meteorological conditions, can be taken into account, but the standard must be at least as stringent as NSPS. Finally, in nonattainment areas, states must adopt LAER standards for new sources. LAER is defined as either of the following: the most stringent standard contained in the implementation plan of any state or the most stringent emissions limit achieved in practice anywhere. Questions of economic and technical feasibility are not supposed to play a role in determining LAER. Moreover, LAER is a general standard applicable to all sources in nonattainment regions and hence is not determined on a case-by-case basis. For a thorough discussion of these distinctions, see NATIONAL COMM'N ON AIR QUALITY, *supra* note 17, pt. 3, chs. 4, 5 & 7.

21. Although in theory there are three different types of standards for new sources (NSPS, BACT and LAER), "in practice, these will all be defined about the same, but only after lengthy negotiations in each case." FORD FOUNDATION, ENERGY: THE NEXT TWENTY YEARS 384 (1979). One study for the National Commission on Air Quality reviewed 54 cases in which LAER standards had been adopted, and found that in all but two cases the LAER standard was the same as the NSPS. The principal reason for the equivalence of the three types of standards is thought to be that regulators do not have sufficient information about alternative abatement methods to make practical distinctions among them. *See* NATIONAL COMM'N ON AIR QUALITY, *supra* note 17, at 3.4-51.

22. NATIONAL COMM'N ON AIR QUALITY, *supra* note 17, at 3.4-43.

hence, a complicated production facility can have numerous separately regulated sources. The bubble policy allowed a firm to treat all of the sources at one facility as if they were one combined source, and to adopt any technical methods that would reduce total emissions — even if this meant allowing emissions to increase at some of the sources.[23] In essence, this policy treats a single plant as a tiny tradable permits market, in which the owners of the plant can make trades of emissions among sources as long as the result is a net reduction in total emissions.

The offset and bubble policies had two important consequences. First, they recognized, albeit implicitly, that giving a firm a permit to operate a polluting facility if it is in compliance with regulatory standards conveys a limited property right. Standards, once promulgated, establish the share of a firm in the overall emissions limit for a region, just as a real estate acquisition conveys to the firm a share in the total amount of land that is zoned for a particular use. Of course, the limitations, conditions and security of rights differ between permits to emit and titles to land.[24] Nevertheless, because having a permit is clearly superior to not having one — indeed, it is essential to operations, just as is having rights to use the land — the permit constitutes a valuable asset to a firm.

The second important consequence of controlled trading options was that the ability to make trades of emissions between sources enhanced the value of emissions permits. If source-specific standards at a plant are economically inefficient because marginal abatement costs differ among sources, bubbles allow the firm to shuffle permits among its sources so as to reduce total compliance costs — and hence enhance the value of the company. As long as incremental abatement costs are lower for old sources than for new sources in compliance with the controlling new source standard — a condition that is guaranteed by the NSPS, BACT and LAER policies — the offset policy enhances the value of permits by allowing them to be sold for more than the costs of further abatement.

A. *Political Consequences of Controlled Trading*

The significance of the property right implicit in emissions permits lies in the role that this right plays in shaping the politics of change in environmental policy. To the extent that political participation — and hence the politically feasible set of changes in policy — is determined by the

23. Air Pollution Control; Recommendation for Alternative Emission Reduction Options Within State Implementation Plans, 44 Fed. Reg. 71,780 (1979) (EPA Policy Statement).

24. For a discussion of the legal position of emissions permits, see Krier, *Some Legal Aspects of Tradable Emissions Permits for Air Pollution in Southern California*, in 2 CASS, HAHN & NOLL, *supra* note 3, ch. 4.

economic stakes that affected parties have in the policy, the very existence of a standard-setting process establishes constraints on feasible reforms. For example, Ackerman and Hassler have argued that the new source performance standards for coal-fired power plants were written into the Clean Air Act Amendments of 1977 because of the benefits the standards would confer on eastern coal interests and firms already holding permits.[25] Crandall adds the additional insight that the winning political coalition behind the NSPS for power plants included Northeastern and Midwestern interests that were trying to slow the growth of the Sunbelt states.[26] These are specific examples of a more general feature of the existing approach to air pollution regulation: Source-specific standards, although resisted prior to their adoption, can be competitively advantageous to established firms because they give old sources a cost advantage over new ones and erect an entry barrier to potential competitors. Moreover, the emissions permits associated with source-specific standards are valuable assets because they may eventually be sold for more than the cost of an offsetting amount of abatement. Any reform proposal that undermines these valuable attributes of existing permits is likely to face resistance from industrial polluters who already hold permits.

Of course, the importance of the constraints created by the system of source-specific standards turns on the value of existing permits compared to the reductions in overall abatement costs that a market in permits could produce. Our work on the likely effects of implementing tradable emissions permits for sulfur oxides (SOx) emissions in Los Angeles indicates that the wealth embodied in existing permits is indeed quite substantial, probably much greater than the efficiency gains that could be captured by allowing these permits to be fully tradable. Figure 1 shows the demand curve for a permit to emit a ton of SO2-equivalent in Los Angeles for one day.[27] The demand curve is calculated by estimating the abatement cost function for each source category in Los Angeles,[28] and solving for the cost-minimizing distribution of emissions among sources for each ceiling on total emissions.[29] The values along the horizontal axis in Figure 1 re-

25. B. ACKERMAN & W. HASSLER, CLEAN COAL/DIRTY AIR, (1981).

26. Crandall, *Controlling Industrial Pollution: The Economics and Politics of Clean Air,* in REGULATORY REFORM IN PUBLIC UTILITIES, (Crew ed. 1982).

27. Sulfur is emitted in many chemical forms, some of which are sulfates but the most important of which is SO2. As SO2 is transported in the atmosphere, it is converted to sulfates. Consequently, for purposes of sulfate air quality management, the relevant measure of emissions is the total amount of sulfur emitted. Because the various chemical compounds that contain sulfur have different weights per unit of sulfur content, the standard practice is to convert to SO2-equivalent weights — that is, the amount of SO2 that would contain the same amount of sulfur. *See* CASS, *supra* note 16, ch. 2.

28. For further details on abatement costs, see 3 CASS, HAHN & NOLL, *supra* note 14.

29. The reason for selecting the emissions ceilings shown in Figure 1 is discussed *infra* text accompanying notes 44-45.

present possible ceilings on total emissions.[30] The standards currently in place allow approximately 350 tons per day of SO2-equivalent to be released into the atmosphere in Los Angeles.[31] As the figure indicates, at 350 tons per day a permit to emit one ton for one day would be worth $470. This translates into a permit value of over $170,000 if the holder can emit one ton per day for an entire year. Thus, the aggregate value of existing permits to emit 350 tons per day for a year would be approximately $60 million if permits were freely tradable. By contrast, total annual compliance costs under the distribution of permits by a market would total an estimated $123 million, and the efficiency gain from a market — the reduction in estimated compliance costs from correcting current inefficiencies — would be less than $10 million.[32] These calculations reveal that regulation of SOx emissions in Los Angeles has created a new property right — a permit to emit — that is half as valuable as the compliance costs that have been undertaken to meet existing standards and roughly ten times as valuable as the short-run efficiency gains to be derived from making permits freely tradable.

30. These calculations are based on three assumptions: (1) that the market for permits is competitive and hence achieves a given emissions target at minimum total cost; (2) that use of natural gas as a boiler fuel is constrained somewhat below the market-clearing quantity at deregulated prices, as has been the case during the early 1980's due to the remaining vestiges of price and allocation regulation of natural gas; and (3) that each firm's production is unchanged by the introduction of a permits market.

31. Cass, *Technical Aspects of the Los Angeles Sulfur Oxides Air Quality Problem,* in 2 CASS, HAHN & NOLL, *supra* note 14, at 69.

32. The $123 million figure is the sum of annualized expenditures on abatement by all regulated source categories if abatement costs are minimized. This is less than a $10 million savings over our estimate of current annualized abatement costs, using the same cost data and the emissions inventory by source category under current regulations. The estimated compliance cost under a market arrangement is probably biased upwards, and the short-run efficiency gain from a market biased downwards, to the extent that control methods are available that have not been incorporated into our abatement cost functions. Only abatement methods for which we could obtain documentation in public sources have been included; this causes us to exclude changes in production processes that are available to firms but are trade secrets, and control methods available to sources that have not yet been regulated. In addition, long-run efficiency gains will be greater to the extent that the market stimulates cost-saving innovations in abatement technology and reduces barriers to economic change. For further discussion of the procedures for cost estimation, see 3 CASS, HAHN & NOLL, *supra* note 14.

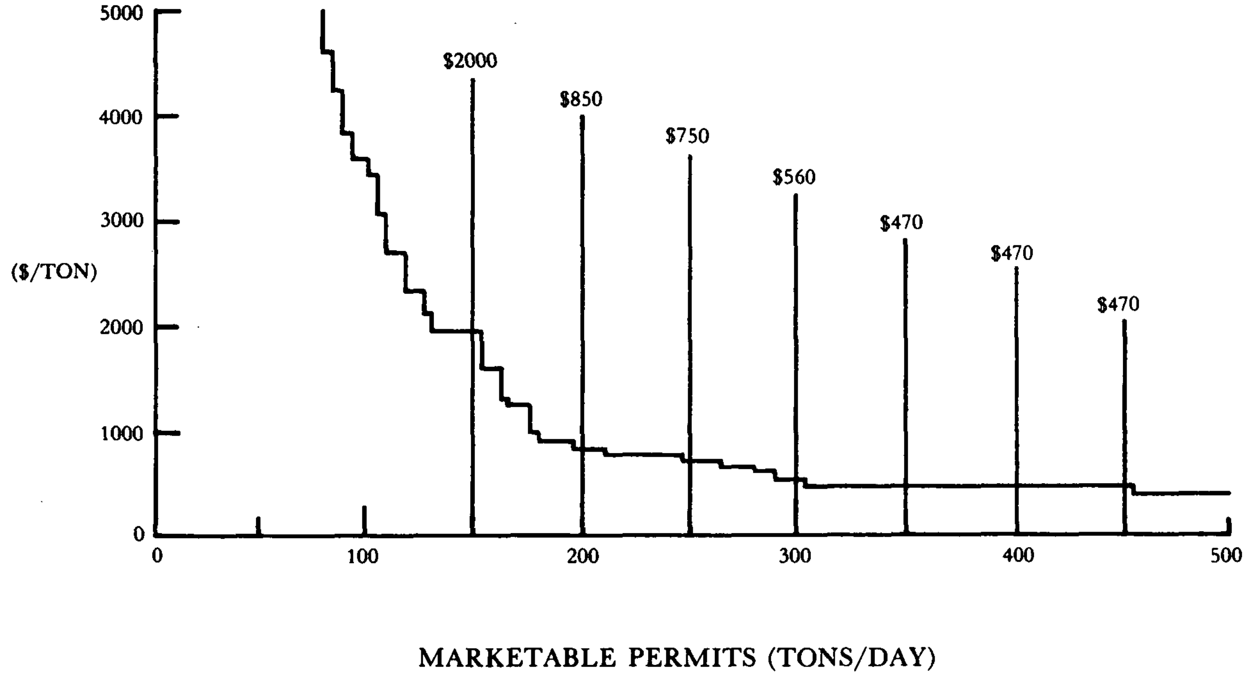

FIGURE 1

MARKET DEMAND FOR PERMITS TO EMIT SULFUR OXIDES IN LOS ANGELES BASED ON ACTUAL 1980 AVERAGE AVAILABILITY OF NATURAL GAS

Source: Calculated by authors from data on abatement costs by source category, as explained in text.

These numbers explain industry resistance to the two most straightforward alternative methods for introducing incentive-based environmental regulation: an emissions tax or an auction of emissions permits. According to our calculations, the 1980 concentration of sulfate particulates in Los Angeles could be attained if all standards were abandoned and replaced by an emissions tax equal to approximately twenty-five cents per pound of SO_2-equivalent emissions.[33] Alternatively, the state could auction off permits to emit 350 tons per day. The net result of either policy would be to transfer approximately $60 million a year from existing pollution sources to the state with no attendant improvement in air quality and with a reduction of only a few million dollars in total annual abatement expenditures.

Allowing present polluters to keep all of the $60 million annual value of existing emissions permits is not, of course, an insurmountable political constraint on the feasible set of environmental reforms.[34] It is more a factor to be considered in designing a system of tradable permits. The current approach, which uses existing standards as the baseline from which trades can be made, is politically attractive because it grandfathers the wealth position of current permit holders. Unfortunately, simply to grandfather permits and to let polluters arrange trades is not the most efficient way to organize a market, because (1) it requires bilateral negotiations; (2) it does not incorporate a mechanism whereby transaction terms become matters of public record (and hence convey meaningful information to potential participants in the market); and (3) it can cause severe market structure problems. Our calculations indicate that in Los Angeles the strategy of grandfathering produces a market that is highly concentrated on the demand side.[35]

33. The emissions tax that would produce the same emissions as current source-specific standards is the market value of a permit to emit a pound of sulfur. The figure of twenty-five cents was derived by dividing the $470 value of a permit to emit one ton by 2000 pounds.

34. The effect on equilibrium prices and wages of the introduction of a tradable permits system does not depend on whether, initially, firms are given or must purchase the permits. In either case, the permits have an opportunity cost equal to their market price, and it is this opportunity cost that enters into the decisions of polluting firms about production plans and product prices. The only exception to this general theoretical observation is the electric utility industry, in which economic regulation may cause the distinction between granted and purchased permits to matter in setting electricity prices. This is the subject of Section III *infra*.

35. See Hahn & Noll, *supra* note 12, at 126, for a detailed analysis of the problems of market structure. The essence of the problem is that public utilities are usually required to undertake significantly more costly abatement methods than other major sources. Consequently, in a market in which firms can trade existing permits, the utilities can constitute the entire demand side of the market. In Los Angeles, we estimate that the largest utility would account for approximately 85 percent of total demand, and the remainder would be from other utilities.

B. *The Zero Revenue Auction of Permits*

If the only available methods for implementing tradable permits were to have the state sell them or to let polluters negotiate from the baseline of current emissions standards, the prospects for effective reform would be gloomy. Fortunately, an alternative is available: a "Zero Revenue Auction."[36] This procedure allocates permits provisionally on the basis of current emissions, but uses a type of auction to make the final allocation. All participants in the emissions market must submit a demand curve for permits, i.e., a statement of the quantity of permits to be purchased for each possible price. Probably most firms would express their demand curves as a step function — for all prices below \$A, purchase will equal x; for prices between \$A and \$(A + B), purchases will be y; and so on. These individual demand curves are then added to construct a market demand curve for permits. The market price of a permit is determined by the intersection of the cumulative demand curve with the ceiling on total emissions. A firm's final allocation is its demand at this price. Each firm then pays an amount equal to the permit price times its final allocation, and receives back an amount equal to the price times its provisional allocation. Net payments to the state are zero for all firms taken together. For each firm, a net payment differing from zero represents an improvement from the status quo ante in terms of the sum of abatement costs plus net permit payments as long as the firm reports a demand curve that is not perversely untruthful.[37] This procedure preserves the wealth inherent in existing permits; provides a thick market with low transactions costs; results in a public price signal for future reference by firms contemplating entry or expansion of polluting facilities; and attacks the market structure problem by placing all firms on the demand side of the market. The drawbacks of the Zero Revenue Auction are that it is somewhat more difficult to understand than simple grandfathering and that it makes participation in the market mandatory, rather than voluntary. The latter drawback is mitigated by the fact that firms can guarantee a final allocation equal to the provisional one at no net cost by reporting a perfectly inelastic demand at the provisional quantity. If every firm so reported, the provisional allocation would be the final allocation, and neither dollars nor permits would change hands; however, unless the provisional allocation minimizes abate-

36. Hahn & Noll, *supra* note 12.

37. A firm that perceives that it can affect the equilibrium price of permits will not necessarily report its true demand curve; however, the trades that result will still be mutually beneficial to all firms in the market. The amount of monopoly power and the extent to which market structure problems cause an inefficient distribution of permits depend on the method used to initialize the market. For a detailed treatment of these issues, see Hahn, *Market Power and Transferable Property Rights*, Q. J. OF ECON. (forthcoming).

ment costs for the associated emissions ceilings, firms would be acting irrationally if they all reported perfectly inelastic demands. Thus, it appears that the Zero Revenue Auction can surmount the barriers, created by current regulations, to implementing an efficient tradable permits system.

II. Natural Gas Regulation as a Constraint on Environmental Reform

The calculations in the preceding section were based upon a specific assumption about the availability and price of natural gas. It is well-documented that price regulation of natural gas at the wellhead has led to excess demand.[38] As regulation of natural gas — especially new discoveries — has gradually been withdrawn,[39] supplies have increased. Because natural gas is exceptionally clean-burning, it is an attractive fuel for use in regions suffering from heavy air pollution. For the problem at hand — sulfate particulates in Los Angeles — it is especially attractive because it contains virtually no sulfur. Hence, substitution of gas for oil — the principal fuel burned in Los Angeles boilers — is the least expensive abatement strategy available for any pollution source that can burn both fuels.

A. *The Availability of Natural Gas*

The importance of the availability of natural gas is illustrated in Table 1, which shows the annual abatement cost for satisfying various limits on total emissions under three different assumptions about the availability of natural gas. All calculations assume that the price of natural gas equals the BTU-equivalent price of high-sulfur residual fuel oil. The "High" and "Low" natural gas cases are drawn from projections of the supply of natural gas to Los Angeles that were made in the mid-1970's, whereas the

38. *See, e.g.*, MacAvoy, *The Regulation-Induced Shortage of Natural Gas*, 14 J.L. & ECON. 167 (1973).

39. The Natural Gas Policy Act of 1978, 15 U.S.C. §§ 3301-3432 (Supp. V 1981), sets forth a procedure that was expected to deregulate gas gradually over a period of several years.

middle column is based on the actual use of gas in 1980.[40]

TABLE 1
ESTIMATED ANNUAL ABATEMENT COSTS FOR ALTERNATIVE CEILINGS ON SO_X EMISSIONS UNDER THREE ASSUMPTIONS REGARDING NATURAL GAS SUPPLIES
(In Millions of 1977 Dollars)

SULFUR OXIDES EMISSIONS (tons/day)	NATURAL GAS SUPPLY		
	High Forecast	Actual 1980	Low Forecast
150	$ 109	$ 182	$ 622
200	93	158	566
250	81	144	524
300	72	131	487
350	64	123	459
400	56	114	440
450	49	106	424

Source: Calculated by authors from data on abatement costs by source category.

Abatement costs under the three conditions of natural gas supply have been calculated for a wide range of aggregate emissions of SOx, as shown in the first column of Table 1. This range includes all of the relevant emissions ceilings for purposes of policy analysis. Emissions of SOx in Los Angeles currently range between 325 and 350 tons per day, averaged over a year.[41] This brings Los Angeles almost into compliance with the relevant federal ambient air quality standards for SO2 and for total suspended particulates.[42] However, approximately a third of the degradation

40. The low availability case represents the predictions then being made about gas supplies for the 1980's, and reflects the view then common that gas supplies would continue to dwindle. Shortly before the development of the "gas bubble," i.e., unanticipated excess supply in the late 1970's, gas supplies in Los Angeles were approaching this level. The high supply case represents a relatively minor shortfall of natural gas supplies from market-clearing quantities at deregulated prices. It is much closer to the actual availability of gas in 1980 — the middle column of the table — than is the low availability case. All three cases assume that existing regulations establishing priorities of user classes, rather than the market, will be used to allocate gas. This assigns highest priority to residential users, and lowest priority to electric generation facilities. In the low and high availability cases, we assigned gas to categories of users according to these priorities. The 1980 case reflects the average pattern of use that actually took place, which may have departed slightly from the assignment we have assumed to the extent that supplies and demands varied through the year. In each case we have assumed that the price of natural gas equals the BTU-equivalent price of high-sulfur residual fuel oil. In fact, gas prices have been somewhat lower than this, so that the availability of natural gas has produced even greater cost savings than are shown in the table. For more details, see Cass, *The Sulfur Oxides Emission Potential of the South Coast Air Basin in the Early 1980s*, in 3 CASS, HAHN & NOLL, *supra* note 14, at app. E.

41. Cass, *supra* note 31, at 66-71.

42. SOUTH COAST AIR QUALITY MGMT. DIST., SULFUR DIOXIDE/SULFATE CONTROL STUDY:

in visibility in Los Angeles is still due to sulfate particulates,[43] and sulfur compounds are a major component of acid rain and acid fog.[44] Consequently, California has set an ambient air quality standard for sulfate particulates that is substantially more rigorous than federal standards and that would require a reduction in emissions to an estimated 150 tons per day. By contrast, under the assumption of low natural gas availability — the conditions that were threatened in the mid-1970's — existing standards would produce emissions of about 420 tons per day.[45] Thus, the emissions ceilings shown in Table 1 range from the outcome with existing standards and low natural gas supplies to compliance with state ambient air quality standards.

Table 1 makes apparent the dramatic effect of the availability of natural gas on abatement costs. Achieving the state standard (150 tons) under the high-availability case is approximately one-fourth as expensive as maintaining the status quo level of emissions (350 tons) if natural gas supplies are curtailed to the low-availability case. On the other hand, if gas supplies increase from the actual 1980 quantity to those projected in the high-availability case, the state ambient air quality standard can be satisfied while simultaneously reducing compliance costs by an estimated $14 million. Obviously, the future of environmental policy in Los Angeles — and in other regions in which natural gas can be an important substitute fuel for coal or oil — depends heavily on the availability of natural gas.

B. *The Price of Natural Gas*

Environmental compliance costs also depend on the price of natural gas. Most forecasts of the effect of deregulation on the price of natural gas predict that complete deregulation in the early 1980's would cause the price to rise steadily until 1990, but not all the way to the BTU-equivalent price for very low-sulfur residual fuel oil (0.25 percent sulfur content).[46] The latter type of fuel is now required for electric utilities in

STAFF REPORT, (1981).

43. CASS, *supra* note 16, ch. 6.

44. *Id.* at 4.

45. These statements about the relationships between emissions and compliance with various air quality standards are based upon information in SOUTH COAST AIR QUALITY MGMT. DIST., *supra* note 42. This information is summarized in Cass, *supra* note 31, at 62.

46. For example, the Office of Policy, Planning and Analysis of the Department of Energy forecasts a 1990 price slightly less than halfway between high-sulfur and low-sulfur residual fuel oil prices, whereas the Energy Information Administration of the same department forecasts that in most parts of the country gas will not reach even the price of high-sulfur residual fuel oil. OFFICE OF POLICY, PLANNING & ANALYSIS, DIV. OF ENERGY REGULATION, U.S. DEP'T OF ENERGY, A STUDY OF ALTERNATIVES TO THE NATURAL GAS POLICY ACT OF 1978 (Nov. 1981) (Doc. No. DOE/PE-0031); 3 ENERGY INFORMATION ADMIN., U.S. DEP'T OF ENERGY 1981 ANNUAL REPORT TO CONGRESS (Feb.

Los Angeles.[47]

TABLE 2

PERMIT PRICES WITH AND WITHOUT NATURAL GAS DECONTROL FOR VARIOUS EMISSIONS CEILINGS[a]

Emissions in SO_2-equiv. Tons/Day	ASSUMPTION ABOUT NATURAL GAS AVAILABILITY AND PRICE						
	Case 1 (2.5%S)	Case 2 (1.0%S)	Case 3 (0.5%S)	Case 4 (0.25%S)	High Forecast	Actual 1980	Low Forecast
150	650	650	650	650	1000	2000	3600
200	80	250	350	470	810	850	2720
250	80	250	350	470	470	750	2020
300	80	250	350	470	470	560	2000
350	80	250	350	470	420	470	1300
400	80	250	350	470	420	470	940
450	80	250	350	470	420	470	850

[a] Price are in 1977 dollars per ton of SO_2-equivalent. The four cases represent four assumptions about natural gas prices under decontrol. The numbers in parentheses are the sulfur content of the residual fuel oil at which the natural gas price is assumed to equilibrate. The "High" and "Low" cases represent conditions of high and low natural gas supply under the status quo (i.e., no decontrol). "Actual" corresponds to actual 1980 fuel use patterns.

Source: Calculations by authors based on abatement cost data by source category.

For firms that can substitute fuels, the cost of compliance with environmental regulations turns on the difference between natural gas and residual fuel oil prices. Table 2 illustrates this by showing estimates of the market-clearing price for a permit to emit a ton of SO2-equivalent in Los Angeles under four different assumptions about the price of gas in a deregulated environment[48] and under the three cases discussed above in which natural gas supplies are partially curtailed (the high, low and actual 1980 cases) and the price is equilibrated with high-sulfur residual fuel oil. The competitive equilibrium price of a permit equals the marginal cost of abatement; hence the differences in permit prices displayed in Table 2 directly reflect the effect of the price and availability of natural gas on abatement costs.

The abatement cost data that underlie the price data in Table 2 reveal three interesting points. First, in all decontrol simulations the amount of natural gas that is burned is the maximum amount that is technically feasible. This point underscores the cost-effectiveness of natural gas use as

1982) (Doc. No. DOE/EIA-0173(81)13). Both studies are based on the assumption of deregulation of gas in 1982.

47. Rogerson, *Electric Generation Plants*, in 3 CASS, HAHN & NOLL, *supra* note 14, at app. F1, describes the current and alternative standards for the sulfur content of residual fuel oil and their effects on utility abatement costs.

48. Natural gas deregulation means more than the end of price regulation. It also means an end to controls on the allocation of gas among users so that the natural gas market is allowed to clear.

a control strategy. Second, the switch from residual fuel oil to gas represents the marginal abatement strategy in all decontrol cases in which the emissions ceiling exceeds 150 tons per day. This means that, for these cases, the price at which natural gas equilibrates with a particular grade of residual fuel oil determines the price of an emissions permit. Third, the price of a permit is generally lower under the four decontrol cases than under the three cases representing the status quo. The only exception to this pattern occurs when the price of natural gas is relatively high (Case 4) and the emissions ceiling is also high (in excess of 300 tons per day).

C. *Uncertainties of Natural Gas Regulation*

A firm that is subject to environmental regulation faces uncertainty due to the presence of natural gas regulation during the past twenty years. By artificially restraining wellhead prices and thereby causing a gas shortage, regulation has deprived firms of information about the performance of a deregulated market.[49] Experience in the regulated market provides little information about the ultimate market equilibrium, or about the extent to which there will be periodic variability in price and availability, if gas is deregulated. Consequently, uncertainty about unregulated natural gas prices and availability in the future is greater than it would have been had gas always been unregulated. In addition, there is uncertainty about the future status of gas regulation. Although the present policy is to move gradually towards full deregulation, it is by no means assured that this progression will be completed and that gas will never again be regulated. The history of the past forty years is one of episodic swings between more and less regulation of natural gas,[50] and the pendulum may still be swinging.[51] In addition, it is unclear how severely gas supplies would be curtailed by a reinstatement of gas regulation and how use priorities might be established if shortages returned.

These uncertainties affect the desirability to polluting firms of a tradable emissions permit system. In a tradable permits system that has no baseline set of source-specific standards, the total number of permits establishes an upper bound to emissions. Hence, all of the uncertainty about the price and availability of natural gas translates into uncertainty about the cost of compliance with environmental regulation, but not about air

49. For example, in an unregulated market the difference between contract price and spot price conveys information about the expectations of producers regarding future discoveries and exploitation costs. This information is useful for customers in making long-term investment decisions concerning fuel burning equipment and abatement methods.

50. *See* M. SANDERS, THE REGULATION OF NATURAL GAS: POLICY AND POLITICS, 1938-1978 (1981).

51. Los Angeles Times, Aug. 7, 1982, pt. 1, at 24.

quality levels.

The current standard-setting system of environmental regulation copes with uncertainty about natural gas in a quite different way. Source-specific standards are usually input standards: For example, a firm must install a scrubber, or use a low-sulfur fuel.[52] Because the availability of natural gas is uncertain, regulators do not require its use. In Los Angeles they require that some sources burn gas if it is available or low-sulfur residual fuel oil if it is not. Electric utilities are required to use natural gas if they can obtain it during the months when pollution is worst, but otherwise to use residual fuel oil that has no more than 0.25 percent sulfur content by weight. This form of standard means that under current regulations total emissions depend on the availability of natural gas. For example, the 1977 standards would produce about 420 tons per day of SO2-equivalent emissions under the conditions of low gas availability that threatened to emerge in the mid-1970's. Currently, emissions average only about 350 tons per day, and if gas were totally deregulated we estimate that emissions would fall to 250 tons per day.[53] Hence, in the current regulatory environment, both air quality and abatement costs bear some of the uncertainty of natural gas availability. Adopting a system of tradable permits in which the total number of permits is set equal to some baseline rate of emissions would place more of the burden of this uncertainty on polluting firms. This provides another reason for firms to resist a system of tradable permits.

D. *Coping with Natural Gas Uncertainties*

A tradable emissions permit system can be designed to avoid the problems arising from uncertainties about natural gas, but the solution surely departs from a simple, unconstrained market for permits. There are two basic ways to deal with these problems: (1) to introduce variability into the emissions allowed by a permit and (2) to adjust periodically the total number of outstanding permits.

Under the first approach, the face value of a permit, i.e., the quantity of SO_2-equivalent emissions that it allows, could depend on the availability

52. A long list of current and proposed source-specific standards is analyzed in *South Coast Air Quality Mgmt. Dist., supra* note 42, and Cass, *supra* note 16. In every case, the standard is expressed in input terms, and the point of the analysis is to calculate the emissions implications of adopting the standard.

53. This estimate was arrived at by calculating the emissions that would result if all fuel users for whom natural gas is a cheaper alternative than residual fuel oil made the switch in fuels. For details of this and other calculations of how to achieve an air quality target with various combinations of gas burning and other controls, see Hahn, Data Base and Programming Methodology for Marketable Permits Study (1981) (Open File Report 80-8, Envtl. Quality Laboratory, California Inst. of Technology).

of natural gas. A permit would then be a contingent claim, subject to a continuing regulatory determination of the current natural gas supply and hence the emissions value of the permit. The variability in total emissions under existing standards could then be incorporated directly into the variability in permit values. This is not easy to implement. A variable permit value would greatly complicate the permits market, and would introduce what is sure to be a time-consuming, expensive, and controversial regulatory process: formal determination of the availability of natural gas.

An alternative method of introducing variability into the value of a permit is to overlay the permit system with natural gas usage requirements — a system of regulations. The permits market would be relied upon to establish the long-run allocation of emissions that would apply under pessimistic assumptions about gas availability. In the short run, holders of these permits would be subject to additional gas-burning requirements if gas were available. This is similar to the current rule that electric utilities must burn gas if it is available during some parts of the year, but otherwise must burn low-sulfur residual fuel oil. As long as gas remains less expensive than low-sulfur oil, this requirement is not likely to be resisted by regulated entities. Nevertheless, such a system will not allow the market to produce a given level of total emissions at minimum cost for the same reasons that current regulations do not produce a minimum-cost solution. Regulators are simply not likely to have enough information and flexibility to specify a cost-minimizing set of gas-burning requirements.

The second and perhaps more likely approach to the uncertainties about natural gas is a permit system that establishes a firm ceiling on emissions, but that also has a procedure for periodically reviewing and adjusting the number of outstanding permits. This approach is not fully consistent with the expressed philosophy of environmental policy to date, which has tended to adopt an absolutist rhetoric: Air quality targets should be set on the basis of health effects and other direct damages, without regard to compliance costs or secondary economic effects of regulation. The artifacts of this attitude include uniform national ambient air quality standards for major pollutants — despite substantial regional differences in the difficulty of achieving them — and nation-wide new source performance standards.

Environmental policy also can be viewed as more a matter of practical economics than of uncompromising constraints. According to this view, environmental policy objectives, such as ceilings on total emissions and ambient air quality standards, ought to depend in part on costs. Thus, higher abatement costs due to rising prices or, under regulation, declining availability of natural gas ought to be reflected in policy adjustments. Current source-specific standards, because they let changes in natural gas supplies affect air quality as well as compliance costs, are actually more consistent with the pragmatic view than with the absolutist position taken in environmental legislation.

The political process is likely to change periodically the goals of environmental policy. Knowledge about the effects of pollution and the attitudes of citizens about the social priority to be given environmental programs can be expected to vary as well. Natural gas policy, too, may continue to change over time. Consequently, uncertainty about the stringency of environmental regulation is likely to persist. One natural way to accommodate this uncertainty is to focus the regulatory process on periodic reappraisals of ceilings on total emissions.

The periodic revision of the Clean Air Act, occasioned by its sunset provision, achieves this accommodation only imperfectly.[54] Because all aspects of the law are reviewed simultaneously, the process of revision focuses attention on general statements of policy and the approach to regulation. With few exceptions, congressional revisions of environmental legislation leave to regulators the task of making trade-offs between environmental goals and other social objectives.[55] Because environmental goals are typically stated as absolutes, regulators tend to write standards and permits as if they were permanent, to be revised only if they fail to achieve environmental objectives.[56]

An alternative approach would be to have a regular expiration date for a significant portion of emissions permits in each region in which a tradable emissions policy is adopted. Regulators would decide, in a formal regulatory process, how many new permits would be created to replace the expiring ones. Among the factors taken into account would be changes in compliance costs, including the availability of natural gas, and new knowledge about the effects of pollution and about the relationship between emissions and air quality. Regulators would also consider the implications of changes in overall policy objectives as enunciated in current versions of the relevant statutes, such as the Clean Air Act. Because these proceedings, including subsequent and predictable legal challenges, would be time-consuming, they could be undertaken only every few years. For

54. The authorization for appropriations expires periodically, and acts as the sunset provision that triggers review of the act. *See* 42 U.S.C. § 7626 (Supp. III 1979).

55. Notable exceptions are the provisions in the Clean Air Act that deal with automobile tailpipe emissions, 42 U.S.C.A. § 7521 (West Supp. 1981), and new source performance standards for coal-fired electric generation facilities, 42 U.S.C.A. § 7411 (West Supp. 1981).

56. The EPA has promulgated elaborate guidelines for state regulators on the procedures to be used in adjusting source-specific emissions standards if ambient air quality objectives are not attained by the State Implementation Plan. A major challenge to EPA was to figure out how traded emissions could fit into this scheme. For a detailed discussion of EPA policy on this issue, *see* ICF, INC., *supra* note 7, at 26.

example, a permit life of ten years could be adopted, with half of the permits expiring every five years.

Periodically expiring permits could be allocated by the Zero Revenue Auction described in Section I.[57] New permits would be provisionally allocated among polluting firms in relation to the holdings of expiring permits, but a compulsory auction process would be used to reallocate them. The exact formula relating the provisional allocation of new permits to holdings of expiring ones would be determined by the regulators, but a likely possibility is that each firm would be given provisionally the same fraction of the new permits that it held of the old.

A system of periodically expiring permits does not fully address the problem that natural gas regulation creates for the implementation of tradable emissions permits. In the short run, at least, emissions ceilings would be fixed, and exogenous shocks to the system would be absorbed completely by changes in compliance costs. But such a system would focus the attention of the regulatory process on periodic reassessment of emissions ceilings in light of new information about the costs and benefits of regulation.

III. Public Utility Regulation and Electric Utilities

The generation of electric power in thermal facilities that burn coal or oil is arguably the most important source of air pollution.[58] For sulfur oxides emissions, this is certainly the case; approximately half of all sulfur oxides emitted in Los Angeles emanates from combustion of oil for generating electricity.[59] Obviously, the performance of any system of air pollution regulation will depend heavily on how it affects emissions by electric utilities.

Incentive-based approaches to environmental control rely upon cost-minimizing behavior by businesses to achieve an efficient allocation of abatement responsibilities among sources. The assumption that electric utilities will minimize costs is debatable, partly because of the effects of public utility regulation. Utility regulators determine the amount of revenue that a utility is permitted to extract from its customers by declaring certain elements of cost to be recoverable. If utility regulators are more likely to allow the recovery of some types of costs than others, or are

57. *See supra* text accompanying notes 36-37.

58. Thermal electric facilities rank at or near the top of the list of major sources of most major pollutants. Their candidacy for the dubious honor of being the most important source of air pollution is arguable, however, because the selection depends upon an assessment of which air pollutants are the most serious problems. *See* BAUMOL & OATES, *supra* note 15, for a comprehensive listing of the most important sources of the major air pollutants.

59. Cass, *supra* note 31, at 69-71.

willing to let utilities earn greater profits on some types of assets than others, regulated firms will have an incentive to depart from cost-minimizing choices of technology and operating methods.[60] The purpose of this section is to consider whether public utility regulation is likely to treat tradable emissions permits in a manner that leads utilities to be efficient in balancing abatement effort and permit holdings.

In general, public utility regulators have been quite deferential to environmental regulation. In California, for example, the Public Utilities Commission has adopted the policy that for the purposes of ratemaking a utility facility is not to be regarded as an electric generation plant and a separate pollution abatement plant, but rather as a single facility with identical principles of cost recovery applied to each activity.[61] This means that public utility regulation distorts incentives for most types of environmental expenses no more than for other utility activities.[62] But for trad-

60. A voluminous literature has developed concerning the effects of economic regulation on the efficiency of regulated firms. Much of this literature consists of theoretical examinations of the effect of rate-of-return regulation on the input choices of regulated firms — the so-called Averch-Johnson effect. This theory assumes that the method of regulation is to limit profits to a fixed proportion of capital investment but to allow firms the freedom to set prices as long as the limit on profit rates is satisfied. The fundamental result of the theory is that this kind of regulation will cause a regulated firm to adopt excessively capital-intensive technology, assuming that the allowed rate of profit exceeds the competitive rate of return. The seminal paper on this topic is Averch & Johnson, *The Behavior of the Firm Under Regulatory Constraint,* 52 AM. ECON. REV. 1052 (1962). In our view, this theory has little practical application to the problems of contemporary public utility regulation because it incorrectly characterizes the focus of the regulatory process. Regulators control profits, but they do so by regulating prices directly and by making decisions about the admissibility for ratemaking purposes of the elements of utility costs. For a description of the regulatory process and a more compelling analysis of the incentives it creates, see Joskow, *Inflation and Environmental Concern: Structural Change in the Process of Public Utility Price Regulation,* 17 J.L. & ECON. 632 (1974). For a survey of the literature on the economic effects of utility regulation, see Joskow and Noll, *Regulation in Theory and Practice: An Overview,* in STUDIES IN PUBLIC REGULATION 1 (Fromm ed. 1981). In any case, our principal concern in this paper is not with whether there are distortions between capital investments and other inputs, but with whether utility regulation is compatible with tradable emissions permits so far as the admissibility of permit costs for ratemaking purposes is concerned.

61. Decision No. 89711, California Pub. Utils. Comm'n (1977).

62. The theoretical work on how utility regulation can cause input distortions can be used in analyzing the incentives facing a utility with respect to the acquisition of emissions permits. If emissions permits are declared a capital asset for ratemaking purposes, utilities will treat them much like capital investments in equipment for abating pollution. According to Averch-Johnson theory, this would mean that both permits and capital equipment would be more attractive than corresponding changes in operating expenses, such as the use of lower-sulfur fuel. Alternatively, the theory propounded by Joskow suggests that the business environment since the early 1970's gives utilities an incentive to distort input choices in favor of operating costs instead of capital investments. *See* Joskow, *supra* note 59, at 325-27. In this case, low-sulfur fuel would be preferred to either increased permit holdings or additional investments in abatement equipment. *See* Isaac, *Fuel Cost Adjustment Mechanism and the Regulated Utility Facing Uncertain Fuel Prices,* 13 BELL J. OF ECON. 158-69 (1982). In both the Averch-Johnson and Joskow theories, the results depend on the assumption that permits will be treated as capital assets. This will not necessarily be done. Utilities could elect to lease the use of permits, in which case the lease payments could be declared operating costs. This would enable a utility to pass through changes in the leasing fee without formal regulatory review by using the fuel adjustment mechanism, which applies to all operating cost categories, not just to fuel prices. This flexibility means that the input distortions created by public utility regulation, whatever their charac-

able permits, the policy of using identical ratemaking principles can be disastrous, depending on how the policy is implemented. The reason is that ratemaking principles in widespread use by utility regulators are likely to result in the confiscation of all utility revenues from permit sales, while allowing no profit to be earned on initial permit holdings.

A. *Ratemaking Methods and Emissions Permits*

In most states the original cost method is used for incorporating the costs of capital investments into the rate base of a regulated utility. Utilities are allowed to recover annual depreciation plus a profit that is calculated by multiplying the allowed rate of return by the current depreciated book value of the original expenditure on capital facilities that the regulators have declared to be "used and useful" for public utility purposes.[63] An alternative to original cost is the replacement cost method, whereby the book value of the asset is periodically adjusted according to changes in its market value. This method produces an estimate of the value of an asset that accounts for inflation and for changes in technology that affect the rate of obsolescence of an old facility. As a practical matter, the two approaches yield essentially the same results. States using a method that produces lower estimates of the book value of capital assets tend to compensate by adopting higher allowed rates of return.[64]

The neutrality of ratemaking methods is not likely to carry over to tradable emissions permits unless they are allocated by auction. If grandfathering is used, initially the utility will hold permits that had zero acquisition cost. Hence, in original cost states the permits must be carried on the books at zero value. No adjustment of the rate of return allowed on this asset can compensate for a valuation of zero, which would cause original cost states to accord a zero profit allowance to grandfathered permits.

A second problem is the treatment of capital gains and losses in utility accounts. Most states use the principles in the Uniform System of Ac-

ter, are not likely to be an important element in utility decisions about permit holdings. For a discussion of the precedents for treating permit costs as operating expenses and the implications of this treatment, see Gerard, *The Effects of Public Utility Regulation on the Efficiency of a Market for Emissions Permits,* in 2 CASS. HAHN & NOLL, *supra* note 14, ch. 5, at 184.

63. One element of public utility regulation is the determination of whether a capital facility ought to be included in the rate base of a utility. The "used and useful" criterion refers to a form of efficiency test: For a facility to be included in the calculation of recoverable costs, it must be providing services to customers and doing so with reasonable efficiency. This part of the public utility process is the defense that regulators have against excessive capitalization (Averch-Johnson effect) or simply bad management and inefficiency. For a discussion of the process for determining the admissibility of cost elements for ratemaking purposes, including a description of the "used and useful" test, see Gerard, *supra* note 61, at 182-183.

64. *See* Primeaux, *Rate Base Methods and Realized Rates of Return,* 16 ECON. INQUIRY 95-107 (1978).

counts established by the Federal Power Commission. The Uniform System of Accounts requires that any gains or losses from the sale of an asset, calculated as the difference between sales price and book value for ratemaking purposes, must be passed on to ratepayers through adjustments in utility prices.[65] In original cost states, this amounts to a 100 percent tax on the revenue from the sale of a grandfathered permit. If a utility sold permits because the costs of the compensating increase in abatement were less than the revenues from the sale of permits, the revenue requirements of the utility would initially fall dramatically. The revenue requirement would increase by the increase in operating expenditures plus the profit on investments for additional abatement, but it would decrease in the first year by the revenue from permit sales. The net effect would be to force the utility to finance the capital investment in abatement equipment from retained earnings or the capital market, rather than from sales of permits. This is unattractive to utilities if the marginal cost of capital exceeds the allowed rate of return, as it generally has since the early 1970's. Even if the abatement method is to use higher sulfur fuel, utilities still face a penalty: The higher costs of low-sulfur fuel can be passed on to ratepayers, but the first-year revenue requirement must also be reduced by the total revenue from permit sales. The net first-year effect of an efficiency-enhancing trade, then, would be higher costs and lower revenues. Hence, the capital gains provisions of utility regulation create an important disincentive to sell permits and to make warranted further expenditures on abatement.

Periodic auctions provide an appropriate incentive structure for utilities. Expenditures on multiyear permits enter as capital assets on which the firm can earn profits, and the periodicity of the auctions keeps the book value of the permits near market value even in original cost states. The problem, of course, is that a standard auction faces the same resistance among utilities as it faces elsewhere: The auction increases the capitalization requirements of a firm, even if it does not change the firm's operating capacity, abatement expenditures, and emissions. What makes matters worse in the utility sector is that here a standard auction generates political opposition from within the government — specifically, from utility regulators. Moreover, since utilities face higher marginal capital costs than their allowed rate of return, both utilities and regulators are even more resistant to new capitalization requirements.

The Zero Revenue Auction is unlike any institution that public utility regulators have ever faced. Consequently, it is somewhat uncertain how they would treat the permits acquired through it. Any net sale of permits

65. FEDERAL ENERGY REGULATORY COMM'N, UNIFORM SYSTEM OF ACCOUNTS at 101-110 (1973).

by a utility would most likely be subjected to the provisions for total capture of capital gains. Because the Zero Revenue Auction produces a final allocation based upon a governmentally organized market process, regulators probably would be inclined to use the resulting permit price to value the final permit holdings of the utility for ratemaking purposes. But if the new permits are to be regarded as acquired at these prices, it is also natural to regard the provisional allocation to have been sold at these prices. Because the initial holdings are grandfathered, their sale is subject to total capture by ratepayers in the year of sale. If so, the firm would have to make a net reduction in electricity rates, equal to the difference between gross sales of the provisional permits and the profits allowed on the gross purchase of new permits. Like a standard auction, this would decapitalize the firm.

In replacement cost states, none of the problems described above would arise. The current price of permits would be used to readjust their value for ratemaking purposes. Their sale would generate a cash reserve for undertaking offsetting abatement investments, for other investment purposes, or for a reduction in the capitalization of the utility by transfers of capital to investors or to non-utility activities.

B. *The Conflicting Purposes of Environmental and Utility Regulation*

The obvious solution to the problem is to convince original-cost states to adopt replacement cost methods for evaluating emissions permits. Unfortunately, there are reasons to doubt that utility regulators will be enthusiastic about this proposal. The original cost method appeals to regulators because of their reluctance to introduce any element of speculation into utility planning, or to allow any significant amount of intangible assets to enter the rate base.[66] For example, regulators do not want utilities to speculate in land acquired for facilities and rights of way; therefore, regulators tend to require that all capital gains on land transactions be passed through to ratepayers.

The argument that regulators are likely to use against allowing emissions permits to enter the rate base at replacement cost is similar to their argument for recapturing speculative land gains. From the viewpoint of the regulators, the utility paid nothing for the permit other than the costs of participating in the environmental regulatory process and complying with the resulting regulations. These costs have already been allowed as part of the utility's revenue requirement. Thus, rising permit values are a

66. For a more complete discussion of the lessons for tradable permits systems to be drawn from the treatment of intangible assets by utility regulators, see Gerard, *supra* note 62, at 186.

windfall gain that ought not to be capitalized in the assets of the firm, and that should be returned to ratepayers if ever realized through sale.

The counterargument is that utilities ought to be given the proper incentive to strike the most efficient balance between emissions and abatement. But similar arguments about allowing replacement cost accounting for assets such as land, water rights, and other intangibles have been unsuccessful in the past because they conflict with the overall aim of regulators to hold down utility prices to consumers. Thus, it is entirely plausible that *any* method of allocating permits and making them tradable will be undercut by regulatory decisions that remove much of the incentive for participation by utilities.

In the specific case of sulfur oxides emissions in Los Angeles, public utilities have been forced to engage in more extensive abatement than have most other sources.[67] Hence, we would expect that with grandfathering, utilities would seek to increase permit holdings. They would then use these additional permits to increase the sulfur content of the fuel burned in electric generation facilities. Their expenditures on a net increase in permits would allow a reduction in fuel costs and could be treated as a capital expenditure on which the firm could earn profits. Regulators would not need to let the grandfathered permits into the rate base in order for utilities to face appropriate incentives in deciding how many additional permits to acquire. Thus, the Zero Revenue Auction, with public utility regulators allowing into the rate base only the net change in permit holdings at the auction price, poses no special problems for this specific case.

This result assumes an initial situation in which utilities are overregulated. States in which utilities have lower marginal costs of abatement than other sources and in which regulators use original cost methods face a significant political problem in trying to implement a system of tradable emissions permits in which utilities will participate efficiently.

IV. Conclusions

Walt Kelley, the author of the famous cartoon strip "Pogo," once gave to one of his characters the immortal line: "We have met the enemy, and they are us." The problems of regulatory interactions warrant such a line. Regulatory policies in one area can create serious political problems in trying to implement a reform in another area and can lead to inefficient market outcomes.

Tradable emissions permits are clearly an idea on the ascendancy. The

67. For a calculation of the change in permit holdings by utilities under various assumptions about the ceiling on total emissions and the availability of natural gas, see Hahn & Noll, *supra* note 12, at 134-137.

Environmental Protection Agency periodically issues policy guidelines that expand the applicability of the concept, and that reduce the bureaucratic barriers to implementing it.[68] The California Air Resources Board is actively pursuing the possibility of experimenting with a full-blown market for sulfur oxides emissions somewhere in the state, as demonstrated by their continued support of and interest in our work on the topic. Yet these initiatives face serious opposition because of the effects of other regulatory policies: the constraints imposed by new source performance standards; the implicit wealth created by existing permits; the uncertainties in the future of fuel supplies and prices owing to the history of regulation of natural gas and even oil prices; and the adverse incentives that current methods of utility regulation create if they are used to guide decisions about how permit values will be incorporated into the rate base of electric utilities.

The solutions to these problems are straightforward in a technical sense. In our work on designing a market for controlling sulfur oxides emissions in Los Angeles, we have demonstrated how a resolution of the wealth distribution issue can be directly incorporated into the design of a permits market. The Zero Revenue Auction can distribute permits efficiently and can accomplish whatever wealth distribution regulators would like to achieve. Uncertainties about natural gas regulation (and regulation of other fuels should it be reinstated) can be taken into account in designing a market institution by introducing flexibility into the ceiling on total emissions and the definition of an emissions permit. Finally, utility regulators can adopt replacement cost methods or other cost-accounting techniques that give utilities appropriate incentives to participate in an emissions permit market.

These solutions require that a system of tradable emissions permits be a more comprehensive departure from current regulatory policy than are EPA's controlled trading options. The controlled trading policy seems to entail a gradual expansion in the range of allowable trades. Two examples are the extension of the bubble concept to multiple plants and the evolution of the offset policy to include emissions reduction banks. This incremental approach deals effectively with only one of the issues raised in this paper: It preserves the wealth created by current standards by using them as a baseline from which trades can be made. On pure efficiency grounds, the merits of the incremental approach can be questioned, for

68. Examples are emissions banking, which expands the offset policy so that the reduction in emissions at one source can occur before the trading partner is identified, and the subsequent decision that trades arranged through the offset and banking policies did not require amendment of the State Implementation Plan and formal approval by EPA. *See* ICF, INC., *supra* note 7.

there are reasons to believe that the resulting permits market will not be competitive. Hence, the incremental approach will not result in an allocation of permits that minimizes abatement costs and will not go as far as possible to facilitate the process of efficient change in technology and in the structure of the economy. But even in the absence of these problems, the issue of interactions between environmental and energy regulation remains. Unless a permit policy is explicitly designed to account for these interactions, the benefits of reform are likely to be substantially lessened.

The analysis in this paper focuses on a specific reform proposal: the implementation of tradable permits for sulfur oxides in Los Angeles. This case exemplifies a more general class of problems that arise in implementing changes in regulatory policy that contribute to economic efficiency. The economics literature on regulation correctly focuses on the efficiency implications of alternative regulatory regimes and uses traditional tools of welfare economics to aggregate the benefits and costs of reform proposals to identify the most efficient policy.[69] These analyses typically assume that all other policies and institutions remain unchanged and that the distributional impact of proposed reforms can be ignored. The case study reported in this paper illustrates two important points: (1) the contribution to economic efficiency of a proposed reform can be greatly influenced by the state of other regulatory policies, and (2) the effects of a change in policy on the distribution of wealth can be very large in comparison to the improvement in economic efficiency. To the extent that effective political resistance to a change in policy is motivated by the economic gains and losses of well-organized groups, successful reform may require that considerable additional work be undertaken to design a policy that not only contributes to economic efficiency but also ameliorates some of the redistributional effects. Most often the method of amelioration that is considered is direct compensation; however, as this paper indicates, another method is to design the new regulatory regime to preserve some part of the old private equities. This strikes us as an approach that has received insufficient attention in the literature on regulatory policy.

69. For a comprehensive review of that literature, see Joskow & Noll, *supra* note 59.