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Back Door Cost-Benefit Analysis under a Safety-First Clean Air Act

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The Clean Air Act is widely recognized as a legislative command to provide the benefits associated with cleaner air without explicit balancing of associated costs. The Administrator of the Environmental Protection Agency (EPA) must, for instance, set a standard for hazardous air pollutants at a level which in his judgment provides an ample margin of safety to protect the public health.[1] The provisions of the Act describing national primary air quality standards require levels of control, "allowing an adequate margin of safety," which are "requisite to protect the public health."[2] Those describing secondary standards prescribe a level of air quality which "is requisite to protect the public welfare from any known or anticipated adverse effects"[3] of air pollutants. There is no suggestion of balancing the costs of reaching these levels with the purported or anticipated benefits. Indeed, the primary standards require "an adequate margin of safety."[4]

In promulgating enumerated regulations and performance standards designed to reach these "safety-first" goals,[5] the Administrator must prepare an economic impact assessment of the regulation or standard,[6] and citizens may sue to require such an assessment.[7] But even if the lack of an assessment is challenged, the adequacy or inadequacy of any assessment is not conclusive for the purposes of judicial review with respect to the requirement that cost be taken into account.[8] Standards for performance of new stationary pollution sources require the *best* system of continuous emission reduction that has been demonstrated for that category of sources.[9] While the standard setter must take into consideration the cost of achieving such emission reduction,[10] it is sufficient when a

1. 42 U.S.C. § 7412(b)(1)(B) (Supp. I 1977).
2. 42 U.S.C. § 7409(b)(1) (Supp. I 1977).
3. 42 U.S.C. § 7409(b)(2) (Supp. I 1977).
4. 42 U.S.C. § 7409(b)(1) (Supp. I 1977).
5. 42 U.S.C. § 7617(a)(1)–(7) (Supp. I. 1977).
6. 42 U.S.C. § 7617(b) (Supp. I 1977).
7. 42 U.S.C. § 7617(f) (Supp. I 1977).
8. 42 U.S.C. § 7617(g) (Supp. I 1977).
9. 42 U.S.C. § 7411(a)(1)(C) (Supp. I 1977).
10. *Id.*

performance standard is promulgated that the EPA has conducted a study
of the financial impact of the standard on the affected industry,[11] consid-
ered relevant factors, and not made a clear error in judgment.[12] A quan-
tified cost-benefit analysis is not required.[13] The protection of the public
health is the "paramount consideration" of the Act.[14]

A former Administrator stated that Congress and the courts have made
it clear that economic considerations must be subordinated to air quality
standards achievement; "the Act does not allow economic growth to be
accommodated at the expense of public health."[15] The Clean Air Act, he
stated, "simply does not allow" a cost-benefit approach.[16] It is generally
accepted that the Clean Air Act mandates a safety-first approach to in-
vestment in air quality.[17]

Safety has not always come first, however, in implementing the Clean
Air Act. Considerations other than safety, some of which may be broadly
denominated economic costs, have prevented full, complete, and perfect
enforcement of Clean Air Act provisions. The selective enforcement that
characterizes much of federal regulatory policy[18] undoubtedly permeates
the environmental arena as well. This article explores how budgeted
enforcement expenditures can be manipulated to contradict safety-first
pronouncements and to result in standards resembling those that might
be determined under a cost-benefit approach. This budgetary control might
originate either in a Congress wishing to demonstrate a safety-first posture
to constituents or in an agency politically committed to reducing the
regulatory burden on emitters.

The practice of the current administration on regulatory policy runs
counter to the safety-first mentality. Governor Reagan's public admon-
ishments to recognize that regulations have costs as well as benefits during
the campaign[19] were translated into President Reagan's Executive Order
12,291 which became effective on February 17, 1981.[20] The regulatory

11. Portland Cement Association v. Ruckelshaus, 486 F.2d 375, 387, (D.C. Cir. 1973), *cert.
denied*, 417 U.S., 921, followed in National Lime Association v. EPA, 627 F.2d 416, 429 (D.C.
Cir. 1980).
12. Portland Cement, 486 F.2d at 402.
13. *Id.* at 387.
14. Union Electric Co. v. EPA, 427 U.S. 246, 272 (1976).
15. 41 Fed. Reg. 55,527 (1976).
16. *Id.*
17. See discussion of cost-benefit analysis in the air quality context by del Calvio y Gonzalez,
Markets in Air: Problems and Prospects of Controlled Trading, 5 HARV. ENVTL. L.R. 377 (1981),
Baram, *Cost-Benefit Analysis: An Indequate Basis for Health, Safety, and Environmental Regulatory
Decisionmaking*, 8 ECOLOGY L.Q. 473 (1980), and Rogers, *Benefits, Costs, and Risks: Oversight
of Health and Environmental Decisionmaking*, 4 HARV. ENVTL. L.R. 191 (1980).
18. Posner, *a Statistical Study of Antitrust Enforcement*, explanations for varying levels of en-
forcement under administrations with different political perspectives.
19. S. REP. NO. 284, 97th Cong., 1st Sess. 8 (1981).
20. Exec. Order No. 12,291, 46 F.R. 13193, 2/17/81.

impact analysis set forth in the Executive Order requires a description of potential benefits and costs of every major rule as well as a determination of the potential *net* benefits.[21] The response of Clean Air Act enforcers has been described as "a wholesale dismantling" of environmental programs through "non-enforcement, weak enforcement or perverse enforcement of the law."[22] Figures show a 69 percent decline from 1980 to 1981 in the number of cases referred by EPA to the Justice Department and a 79 percent decline in the number of cases referred by EPA regions to agency headquarters for eventual referral to the Justice Department.[23] Former EPA Administrator Gorsuch acknowledged a change in policy away from "bean counting" enforcement actions.[24] Stephen D. Ramsey, Chief of Environmental Enforcement at the Justice Department, stated that federal enforcement of the Clean Air Act would focus on prosecution of cases involving only either substantial environmental harm or criminal activity, recognizing that the total number of cases litigated by the Justice Department would decrease.[25] Enforcement policy clearly has an impact on the costs that emitters of pollutants will agree to bear. For an administration concerned with regulatory costs, enforcement budgeting strategy is an option for reducing those costs while convincing Congress to make legislative changes or while maintaining the public impression that regulatory requirements have not changed.

Budgeting enforcement of Clean Air Act regulations in order to reach cost-justified levels of pollution reduction that are less stringent than safety-first levels might be a solution for the Environmental Protection Agency or an administration facing dissonance between public opinion and statutory requirements, on one hand, and its regulatory philosophy, on the other. This article explores the equivalency of direct cost-benefit balancing and balancing through budgetary control; how it might be accomplished and the potential for differences in outcome. Part I presents a property rights oriented model of the costs and benefits of pollution reduction with an emphasis on enforcement costs and demonstrates how the model is interpreted under various regulatory changes in order to clarify the theoretical mechanism involved. Part II demonstrates how this model is translated into the traditional cost-benefit paradigm, and Part III indicates how control of the enforcement budget can be used to approximate the cost-justified outcome and describes the factors influencing the similarity of the two outcomes. Throughout, the focus will be on federal

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21. *Id.* at Sec. 3(d)(1)–(3).
22. *Valley News*, West Lebanon, New Hampshire, July 22, 1982, at p. 6, col. 5, quoting Russell Peterson, President of the National Audubon Society.
23. [12 Current Developments] ENVT'L REP. (BNA) (1982).
24. *Id.* at 1606.
25. *Id.* at 895.

enforcement of pollution control regulations applicable to stationary pollution sources.

PROPERTY RIGHTS IN A REGULATORY CONTEXT

The EPA is charged with primary responsibility for maintenance and enhancement of the nation's air quality. Its regulations are subject to review and modification by Congress and the courts, the former dictating the parameters bounding the EPA's discretion and the latter ensuring that the EPA stays within those, as well as constitutional, boundaries. EPA regulations describing overall air quality standards indicate the level of benefits to which each breather of the air is entitled. These regulations do not explicitly describe benefits to emitters of pollutants even though they are also users of the air and benefit therefrom. Benefits to emitters from use of the air are implicit, however, in what might be viewed as permission to use the air as long as certain conditions, the regulations, are met. Restrictions on type of permissible use indicate who gets the property right to use air and are collectively referred to here as the *direction component* of the property rights assignment.

Regulations specifying norms of behavior with respect to the use of ambient air apply only to emitters. Breathers are not covered by these rules. This means that breathing, as a type of use of the air, is not regulated except by that component of the property rights assignment which specifies a level of air quality to which each breather is entitled. This "benefit level per user" is described in what will be referred to as the *content component* of the property rights assignment, or in the Clean Air Act context, the statements of all relevant portions of the national air quality standards. Of considerable importance to the cost-benefit discussion is recognition of the fact that regulations controlling emissions do not take into account, except in very crude fashion, the number of breathers who benefit from pollution reduction. Thus, the *inclusiveness* of the property rights assignment, a third component, which specifies numbers of permitted simultaneous users of the resource in question here, a body of air, does not reflect the number of simultaneous breathers, only the number of emitters. The focus of this article is on the relationship between the cost of pollution reduction by emitters and the number of emitters. Variations in the number and types of simultaneous emitters in a given geographic area dictate, for a given set of pollution control regulations, the number of dollars which must be spent on air pollution reduction to provide a given level of benefits to each breather.

Our consideration of enforcement budgeting requires a theoretical connection between the air quality standards selected and the cost of enforcing compliance with pollution control regulations. The consideration of this

enforcement issue hinges on a determination of the number of enforcement units (here, the number of enforcement teams) needed to provide a given level of protection to the rights of breathers to a given quality of clean air. The level of air quality and number of emitters who must reduce pollution in a given area determine, for a given set of regulations, the number of units of pollution reduction measured in dollars produced by the emitters in their role as suppliers of the resource, "clean air." The EPA is charged with enforcing the breathers' rights to pollution reduction and is assisted by the breathers themselves, who are given enforcement powers under the Clean Air Act. The *sanctions component* of a property rights assignment specifies permissible alternative means by which prop- erty rights may be protected.

A more detailed examination of EPA regulations and the provisions of the Clean Air Act will indicate how changes in pollution control regulations can be reflected in a property rights model of the institutional structure of the Clean Air Act. This examination will also indicate how changes in the four enumerated components of a property rights assignment, direction, content, inclusiveness, and sanctions, affect the level of costs of enforcing these rights.

THE REDUCTION COST CURVE

In the Clean Air Act context, the reduction cost curve measures the total dollar investment in pollution reduction required by the regulations for various numbers of emitters in an air quality control region (ACQR), given a fixed level of air quality to which each breather is entitled.

The dollar investment in pollution reduction is a measure of the number of units of the good supplied. Turning low quality (dirty) air into higher quality (clean) air is a production process supplying units of the good "pollution reduction." By focusing directly on the investment in resources necessary to this production process, one can avoid measuring the units of the resource in quality terms. Because it is desirable to isolate enforcement problems from the problems of supplying clean air, the costs of enforcing the right to breathe air of a given quality are not included as part of the costs of producing pollution reduction. Production costs include the cost of the control devices and process changes, physical modifications of preexisting technology used in the production of other goods, as well as other costs of complying with the regulations.[26] The costs of complying with legal regulations surrounding production of pollution reduction include the costs of having pollution control devices

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26. The inclusion of compliance costs and the enumeration of these costs is suggested by Downing and Watson, *The Economics of Enforcing Air Pollution Controls*, 1 J. ENVTL. ECON. & MGMT. 219 (1974).

Clean Air Area   Dirty Air Area

1(a)   2(a)
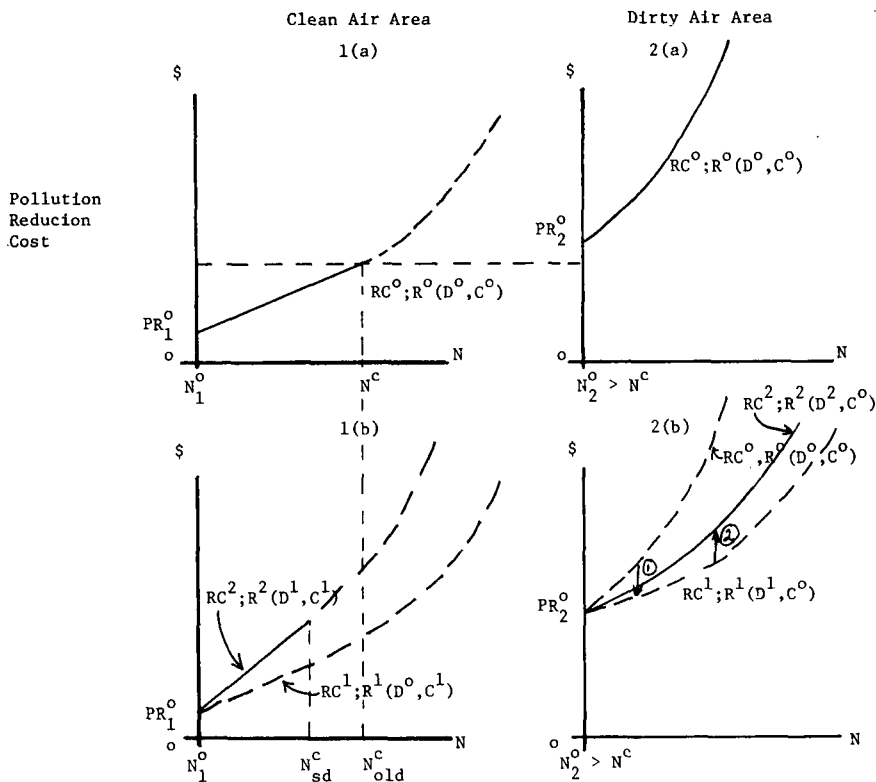
FIGURES 1 and 2.   Changes in Cost Curve Due to 1977 Amendments.

installed, financed, and maintained; of testing to determine compliance of devices with legal requirements; and of having equipment certified as well as the costs of monitoring and keeping records of pollution output. This total cost of production for all emitters in a region is measured on the vertical axis of the reduction cost diagram shown in Figure 1 and 2.

The horizontal axis measures the number of emitters in an AQCR. The AQCR is used as the geographic area for estimating the resource cost curve because the Clean Air Act requires state adoption of an implementation plan specifying the manner in which national primary and secondary air quality standard will be achieved and maintained within each AQCR in the state.[27] States are subdivided so that individual treatment can be

27. 42 U.S.C. § 7407 (Supp. I 1977). The Administrator of the EPA consulting with state and local authorities determines which areas of states will be designated as AQCRs. An AQCR may consist of a number of cities, such as the Hartford-New Haven-Springfield Interstate Air Quality Control Region, 40 C.F.R. § 81.26 (1982); or counties and cities, such as the Valley of Virginia

given to particular trouble spots. An AQCR is designated in an effort to combine in a single sphere of control a geographic area sharing a common resource, i.e., the same batch of air. The geographic area where air pollution is produced by emitters roughly corresponds to the area where breathers inhale it.[28] State implementation plans are approved on the basis of an established classification scheme for each region. The classification is based on measured or estimated ambient air quality and describes the regional characteristics "in order that the time and resources to be expended in developing the plan for that region, as well as the substantive content of the plan, will be commensurate with the complexity of the air pollution problem" in that region.[29] An AQCR is classified by the concentrations of particular pollutants[30] in its air. Higher priority ratings are given for areas with higher concentrations of the pollutants.[31] Stricter controls are applied to emissions of high concentration pollutants in a particular AQCR. Because the concentration of pollutants will depend on the nunber of emitters, the number of emitters of a particular pollutant in a given AQCR will affect the required amount of investment in pollution reduction in that region. Breathers are not included as users of the air in the AQCR measured on the horizontal axis because an increase or decrease in the number of breathers has no impact on the required investment in pollution reduction. This peculiar characteristic of the Clean Air Act is bothersome from a cost-benefit viewpoint; but the reduction cost curve derived to describe the institutional structure of the Clean Air Act will more accurately reflect the law if the horizontal axis measures only the number of emitters in the region.

The shape of the reduction cost curve for any AQCR will depend on the types of emitters subject to EPA control in the AQCR, the restrictions placed on emitters, and the air quality in the region although the quality

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Interstate AQCR, 40 C.F.R. § 81.146 (1982); multiple counties, such as in the Puget Sound AQCR, 40 C.F.R. § 81.32 (1982); or a single political subdivision such as the U.S. Virgin Islands AQCR, 40 C.F.R. § 81.46 (1982); and the State of Hawaii AQCR, 40 C.F.R. § 81.76 (1982). The regulations describe approximately 250 AQCRs. Areas of a state not within a designated AQCR may be joined together as one or separate AQCRs at the discretionof the State. 42 U.S.C. § 7407 (b) (2) (Supp. I 1977). Interstate AQCRs are established to coordinate state policies governing AQCRs covering more than one state. 42 U.S.C. § 7406 (Supp. I 1977).

28. The correspondence is only rough as the problems with acid rain indicate. Also, there is more damage done by pollutants than that done to breathers through inhalation. The focus on breathers (as à proxy for the non-emitter consumer group) reflects the purposes of the Clean Air Act to protect the health, welfare, and productivity capacity of the Nation's population. 42 U.S.C. § 7401 (Supp. I 1977).

29. 40 C.F.R. § 51.3 (1982).

30. Priorities are established for sulfur oxides, particulates, carbon monoxide, nitrogen dioxide, and photochemical oxidants. *Id.*

31. The Central New York Intrastate AQCR, for instance, is classified Priority I with respect to particulate matter, carbon monoxide, and photochemical oxidants, Priority II with respect to sulfur oxides, and Priority III with respect to nitrogen dioxide. 40 C.F.R. § 52.1670 (1982).

of air in the region indicates generally which set of rules will govern the emitters' activities. There will be two types of regions, clean air and dirty air regions.

Clean air regions have an air quality better than that specified by the national primary and secondary air quality standards, the national standards for hazardous air pollutants, and state and local modifications of these standards. These standards establishing the quality of air to which breathers are entitled will be referred to collectively as the national standards. These standards generally state maximum levels of concentration for each controlled pollutant.

Clean air regions are also subject to a second set of standards, the rules for prevention of significant deterioration of air quality or PSD rules.[32] Designed to prevent air in clean air regions from deteriorating to the level of the national standards, the PSD rules specify maximum allowable increases in concentration of controlled pollutants over a baseline concentration. The three classes of clean air areas (Class I in the cleanest region to Class III for the areas where more deterioration is to be allowed) are governed by the same procedural rules although different increments are allowed for the controlled pollutants in areas of different classes.[33] If, in a clean air region, the PSD rules have been violated, i.e., the concentration of any controlled pollutant exceeds the allowable maximum (defined in terms of baseline concentration plus permissible increase), that region is designated a nonattainment area with respect to that pollutant. A third set of rules, the nonattainment rules, applies to nonattainment areas.[34]

Dirty air regions are those which do not meet the national standards for one or more controlled pollutants. A dirty air region not meeting the national standards for a pollutant is designated a nonattainment area with respect to that pollutant and is subject to the nonattainment rules.[35]

The PSD rules and the nonattainment rules became part of the Clean Air Act with the 1977 amendments.[36] Comparing the resource cost curves of the 1970 Clean Air Act and the Act as amended in 1977 will indicate how that curve is interpreted in this regulatory context.

The EPA's 1970 interpretation of the Clean Air Act was that air in clean air areas, those with air quality above the national standards, would be allowed to deteriorate to a quality equal to the standard while dirty air areas were required to improve air quality to meet national standards. The result, in principle, was uniform air quality in all areas.

32. 42 U.S.C. §§ 7470–79 (Supp. I 1977).
33. 42 U.S.C. §§ 7472–73 (Supp. I 1977).
34. 43 U.S.C. §§ 7501–08 (Supp. I 1977).
35. 42 U.S.C. §§ 7501(2) (Supp. I 1977).
36. Clean Air Act Amendments of 1977, Pub. L. No. 95–95, 91 Stat. 685.

Diagramatically, the reduction cost curve for each type of area appears as shown in Figures 1(a) and 2(a). In each type of area we assume an initial number of emitters, N°_1, for the clean air area and, N°_2, for the dirty air area. The congestion point, N^c, in the 1970 Clean Air Act context is reached when so many emitters are releasing pollutants into the air in an AQCR that the national standards are violated.[37] The clean air area may be defined as one in which N°_1 (the initial number of emitters) is less than N^c. The dirty area is one in which N°_2 is greater than N^c.

Note that the congestion point can be reached in a particular AQCR even if all emitters are complying with performance and specification standards for emission reduction required by EPA regulations. Performance and specification standards do not require that emissions be reduced to zero. Performance standards indicate how much of a given pollutant each emitter may release while specification standards indicate what technology must be used to reduce (not eliminate) emissions. The reduction-cost curves in Figures 1 and 2 indicate that, even without an increase in the number of emitters, existing emitters must bear pollution reduction costs equal to PR°_1 in the clean air area and PR°_2 in the dirty air area.

In the clean air area depicted in Figure 1(a), the investment in pollution reduction required of entering emitters by performance and specification standards is measured by the reduction cost curve between N°_1 and N^c. Note that this is *not* the increased investment necessary to provide a given level of air quality to breathers. The air is still of a quality better than the quality to which breathers are entitled. Existing as well as entering emitters are reducing pollution in order to comply with the regulations. The upward sloping curve between N°_1 and N^c describes this increasing total investment required by the Act as the number of emitters increases.

To the right of N^c in Figure 1(a) or N°_2 in Figure 2(a), both of which describe the reduction cost curve for a nonattainment area, the curve becomes steeper. Clean Air Act policy in 1970 was to permit no further deterioration once the congestion point is reached. New entrants were not permitted to add any new emissions to the ambient air. This requirement of complete elimination of pollutants by the new entrants imposed greater pollution reduction costs on each new emitter than were imposed

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37. In the theory of quasi public goods, the congestion point is a level of intensity of resource use indicated by the point at which the number of simultaneous users of the good in question is so great that the benefits each user derives from the provision to all users of a fixed number of units of a good begins to decline. Translated into the clean air context, the congestion point is that point at which the intensity of emissions is so great as to interfere with the standards governing simultaneous emissions by others. The interference in this statutory context plunges the AQCR into nonattainment status with respect to the particular pollutant involved. Thus, the cost of compliance with the rules increases. The property rights model employed here was initially developed in Barnes, *Enforcing Property Rights: Extending Property Rights Theory to Congestible and Environmental Goods,* 10 B. C. ENVIR. AFF. L. R. 583 (1983).

on each old emitter who merely had to comply with specification or performance standards. Thus the reduction cost curve to the right of N^c on RC^o in Figure 1(a) and curve RC^o in Figure 2(a) rise more steeply than the curve for the clean air area, RC^o to the left of N^c in Figure 1(a). The slope of the curve in the dirty air area reflects the cost of totally eliminating pollutants from emissions. Total elimination may be technologically impossible in many situations, in which case the curve would measure opportunity costs of deterred would-be emitters. Generally it has been suggested that costs of removal increase sharply as percentage removal increases.[38]

Figures 1(b) and 2(b) reflect the change in the reduction cost curves under the property rights scheme established by the 1977 amendments to the Clean Air Act. The PSD rules apply to an initial number of emitters in the clean air region equal to N^o_1 and limit the deterioration of air quality to a maximum change in the pollutant concentration depending on the classification of the region. As under the 1970 Act, existing emitters are assumed to provide pollution reduction equal to PR^o_1 and new entrants must comply with performance and specification standards. But this situation will not be allowed to continue until the old congestion point, N^c, is reached. Once the maximum allowable increase is reached, the air is not allowed to deteriorate further. That point is N^c_{sd} in Figure 1(b). Further deterioration would cause this clean air area to be designated a nonattainment area.[39] RC^1 is reduction cost curve reflecting this change.

This change in property rights is a change in the content component of the right of breathers to consume air. Recall that the content component describes the level of benefit to which each breather is entitled. The assigned level of benefits increases as a result of this reassignment. Each breather is now entitled to air of a quality no worse than the maximum allowable increment added to the baseline concentration under the PSD rules.

Under the 1977 amendments dirty air areas are also defined as nonattainment areas. The nonattainment rules applying to new entrants into a dirty air area (or a clean air area which has exceeded its maximum

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38. *See* Downing and Watson, *supra* note 26, at 220.

39. Note that there may be cases where the maximum allowable increase in pollutant concentrations when added to existing pollutant concentrations would create an air quality lower than the national standards. Such a situation is not permitted to occur. The PSD rules introduced in Section 127 of the Clean Air Act Amendments of 1977 state that the concentration of pollutants is not permitted to exceed the lower of the sum of the baseline concentration (that concentration of pollutants which exists at the time of the first application for a permit to construct or modify a source in the region) plus the maximum allowable increase over that concentration or the national standards. 42 U.S.C. § 7473 (Supp. I 1977). In a case where the baseline concentration plus the maximum allowable increase exceeds the national standard for a particular pollutant, the national standard is followed and $N^c_{sd} = N^c_{old}$.

allowable increase in concentration for any pollutant) require that the new entrant, in his permit application, demonstrate that:

> by the time the source is to commence operation total allowable emissions from existing sources in that region, from new or modified sources which are not major emitting facilities and from the proposed source will be sufficiently less than total emissions from existing sources . . . so as to represent . . . reasonable further progress [toward the goal of attainment of the relevant standards].[40]

The new facility need not totally eliminate its own pollution. It may instead reduce "total emissions" by making a deal with existing emitters to reduce emissions from existing facilities. Instead of total elimination of emissions under the old rule, entrants may "offset" their increases by decreasing existing emissions.

The "no-growth" policy of the old rules[41] has been replaced with a mechanism designed to lower pollution reduction costs to new emitters. This implies a downward shift in the reduction cost curve in nonattainment areas from the 1970 Clean Air Act property rights structure. Diagramatically the old curve RC^0 in Figure 2(a) has shifted to RC^1 in Figure 2(b).

This shift is a result of a change in the direction component of the property right assigned to emitters. Recall that the direction component specifies the type of emitters who may use the air in the AQCR. Prior to the 1977 amendments the only new emitters permitted in dirty air areas were those who could completely eliminate their own emissions. Now, the only new emitters permitted are those who can comply with relevant performance and specification standards and demonstrate a net benefit from their entry.

By way of further demonstration of the use of the model in capturing the reduction cost effects of changes in property rights assignments, consider that even while decreasing some costs to entry, the nonattainment rules increase other costs. Compliance costs include not only the costs of the control device but also the costs of permits, inspections, monitoring, and fulfilling various legal requirements for certification. Among the additional costs imposed by the nonattainment rules are costs of processing permits and demonstrating the required reasonable progress, costs of constructing the new source in order to comply with the lowest achievable emission rate, and costs of bringing all other major stationary sources owned or operated by the same emitter into compliance.[42]

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40. 42 U.S.C. § 7503 (Supp. I 1977).

41. This characterization of the policy is common in the literature. *See, e.g.,* Raffle, *Prevention of Significant Deterioration and Nonattainment under the Clean Air Act: A Comprehensive Review,* 10 ENV'T REP. (BNA) Monograph No. 28 (May 4, 1979).

42. 42 U.S.C. § 7503 (Supp. I 1977).

So while the costs of control may fall, the costs of demonstrating compliance with the other terms, a type of transaction cost, will depend on each individual case. If the nonattainment rules work as planned, cost of control to entrants will be lower as in RC^1 in Figure 2(b). Transaction costs, however, will moderate this lowering so that the resulting reduction cost curve is RC^2.

Similar transaction costs imposed on new entrants to clean air area by permit systems embodied in the PSD rules raise the reduction costs curve from RC^1; R^1 (D^o, C^1) to RC^2; R^2 (D^1, C^1) in Figure 1(b). Both shifts due to transaction costs reflect changes in the direction of the assignment to those types of emitters who comply with details of the permit system.

THE ENFORCEMENT RELATION

In the Clean Air Act context, the enforcement curve relates the quantities of resources devoted to protecting or enforcing property rights to clean air to the quantities of resources devoted to the production of clean air. By hypothesis, the more resources that emitters of pollution must devote to pollution abatement, the more they will, *ceteris paribus*, resist compliance with emission control regulations. Under the Clean Air Act, all emitters are entitled to consume the air as long as they comply with rules requiring abatement, and the enforcement task is to force emitters to bear the costs of compliance with those rules.

Public enforcement of Clean Air Act provisions is by federal, state, and local officials; public interest groups dominate private enforcement. We will focus on the process of enforcement by governmental agencies recognizing that enforcement expenditure by non-governmental advocates of rights to clean air must also be included in any general model of enforcement costs. An implication of allowing for private/non-governmental enforcement of rights is the inability of regulatory institutions to control the sum total of enforcement expenditures.

The enforcement position of state officials is described as "first option." State authorities are allowed to proceed with enforcement prior to federal intervention although enforcement actions do conflict on occasion.[43] Enforcement can be traced through stages of inspection and monitoring of pollution sources, issuing warning letters to violators of standards, conferences between enforcers and emitters, voluntary agreements or forced

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43. *See, e.g.,* Getty Oil v. Ruckelshaus, 467 F.2d 349 (3d Cir. 1972), where the EPA issued an order for the oil company to comply with regulations while the company had an outstanding appeal on a denial of a variance by a state agency. For a discussion of the problem of consistency in the national strategy for enforcement caused by having both State and Federal enforcement processes, *see* Olds, Unkovic, and Lewin, *Thoughts on the Role of Penalties in the Enforcement of the Clean Air and Clean Water Acts,* 17 DUQUESNE L. REV. 1 (1978) and Bullwinkel, *Environmental Law— The Uneasy Accommodation between State and Federal Agencies,* 25 DEPAUL L. REV. 423 (1976).

orders to comply, and fines and/or court-ordered injunctions. Enforcement officials are given some discretion by the Clean Air Act in their choice and application of various enforcement tools. The enforcement process is described in what has been referred to as the sanctions component of the property rights assignment. Just as the ability of a farmer to protect his cornfield by planting land mines around the perimeter is crucial to the value and definition of his property right, the ability of the Clean Air Act enforcer to assess a fine for noncompliance equal to any economic gain the polluter may have had due to noncompliance[44] affects the enforceability of rights to clean air and the productivity of enforcement agents.

If we have a complete specification of the four components of the property rights assignment, direction, content, inclusiveness, and sanctions, we can derive a hypothetical relationship describing the number of enforcement units needed to ensure compliance with environmental regulations. With this starting point, the effect of altering the direction, inclusiveness, or content of the rights assignment on the enforcement relation can be described. Figure 3 presents such a point.

The horizontal axis measures dollars of pollution reduction expenses: dollars that emitters must forego to comply with regulations. This is the same as the vertical axis of the reduction cost curve diagram. The number of enforcers, summarized as attorney/engineer teams with their support staffs, is measured on the vertical axis with a fixed number of units of attorney, engineer, and staff comprising a single unit of enforcement. The enforcement curve, E, describes the number of enforcement units needed to ensure that the producers of pollution abatement appropriate the *negative* returns of their productive activity.

The direction component of these rights describes the types of firms subject to Clean Air Act regulations. Permeating the Act is a distinction between "major stationary sources"[45] and others. Significant differences

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44. The amount of noncompliance penalty must not be less than
   (A) The economic value which a delay in compliance beyond July 1, 1979 may have for the owner of such source, including the quarterly equivalent of the capital costs of compliance and debt service over a normal amortization period, not to exceed ten years, operation and maintenance costs foregone as a result of noncompliance, and any additional economic value which such a delay may have for the owner or operator of such source
   minus
   (B) the amount of any expenditure made by the owner or operator of that source during any such quarter for the purpose of bringing that source into, and maintaining compliance with, such requirement, to the extent such expenditures have not been taken into account in the calculations of the penalty under sub-paragraph (A). 42 U.S.C. § 7420(d)(2) (Supp. I 1977).
   45. A "major stationary source" is generally "any building, structure, facility or installation . . . which directly emits, or has the potential to emit, one hundred tons per year or more of any pollutant." 42 U.S.C. §§ 7411(a)(3) and 7602(j) (Supp. I 1977).

Enforcement
Units

Attorney/
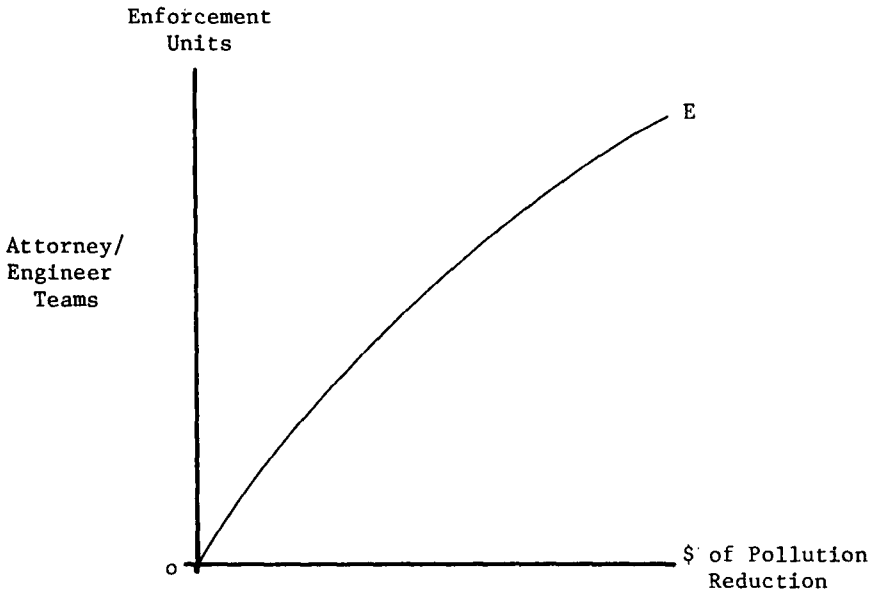Engineer
Teams

E

$ of Pollution
Reduction

O

FIGURE 3.   An Enforcement Relation for the Clear Air Act Context.

between these categorizations include automatic application of specific
new source performance standards to major sources,[46] less discretion on
the part of the Administrator in dealing with such sources,[47] and more
comprehensive construction permit application requirements for major
sources.[48] A change in the direction of the assignment would be one that
required different types of polluters to comply with specific regulations.
For instance, Section 116 of the 1977 amendments to the Clean Air Act
amended Section 118 to subject all federal facilities discharging air pol-
lutants to the same "Federal, State, interstate, and local requirements,
administrative authority, and process and sanctions respecting control and
abatement of air pollution . . . as any nongovernmental entity."[49] To the
extent that this means that there will be new types of emitters subject to
control, a change in the direction of the assignment has occurred, and
the difficulties and costs of enforcing Clean Air Act requirements against
federal facilities must be considered. The new difficulties may be tech-
nological, as for governmental facilities engaging in production processes

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46. 42 U.S.C. §§ 7411(f)(1), (f)(2) and (g)(2) (Supp. I 1977).

47. 42 U.S.C. §§ 7413(b) and 7420(a)(2)(A) (Supp. I 1977).

48. 42 U.S.C. §§ 7410(a)(2)(K), 7426, 7502(a)(b), 7503, 7574(b)(1)(c), and 7604(a)(3) (Supp
I 1977).

49. 42 U.S.C. § 7418 (Supp. I 1977).

not carried out in the private economy, e.g., weapons testing, or legal, such as constitutional failures of state power over federal activities.

Note that to the extent that the enforcement relation shifts due merely to an increase in the number of emitters of a type already controlled, the resulting increased cost is due to a change in the inclusiveness, not the direction of the assignment. If, for instance, major sources were redefined to include facilities with much smaller annual capacity to emit a pollutant, enforcers might need to change strategy to deal effectively with small polluters. Per dollar spent on pollution control, enforcement of compliance by small polluters may take more or fewer enforcement units. Changes in the law or applicable regulations, then, affect the effectiveness, or productive efficiency, of enforcement units. It is more likely that this change in definition shifts the enforcement curve just because of the increase in the number and not in the type of facility involved. This effect is then due to an increase in the inclusiveness of the rights assignment.

A change in the direction and inclusiveness of the assignment may also result from amending the law to cover more pollutants. For instance, the addition of radioactive pollutants to the list of pollutants to be abated is likely to increase the number of enforcement units required to ensure that breathers of the air receive the level of benefits to which they are entitled. We can examine the implications for enforcement planning of some of the effects of this addition: a change in the type of emitter whose abatement must be enforced, an increase in the number of polluters whose violations must be detected and to which enforcers must respond, and an increase in the level of benefits to consumers from air with a lower level of radioactivity. The reduction cost curve shifts from RC^o to RC^1 in Figure 4 as a result of the change in the content and direction components of the right to use the air. The higher quality air promised by the amendment increases the level of benefits described in the content component of the right but can be achieved only at a greater cost in terms of dollars spent on pollution reduction. The reduction cost curve is affected by restrictions placed on pre-amendment emitters of radioactive pollutants who must now incur abatement costs. The shift of the reduction cost curve in Figure 4 reflects both the increased benefits in the contents component and constraints placed on a new type of emitter in the direction component. Given the amendment, the pollution control costs for any number of emitters in the AQCR is higher.

If the addition of radioactive particles to the list of pollutants presents the enforcers with new types of emitters with whom to deal or with more emitters to regulate, the enforcement relation may shift out. This outward shift indicates the greater need for enforcement inputs per dollar of reduction if the newly covered emitters are more difficult to regulate or if the increased number of emitters decreases the productivity of each at-
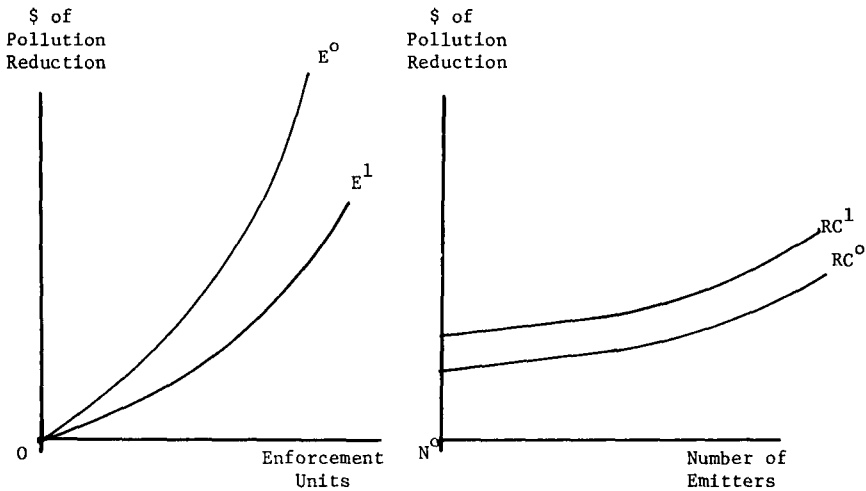
FIGURE 4.   Enforcement Curve Shift-Effect of Radioactive Emissions Standard.

torney/engineer team. It is conceivable that the technology of radioactive pollution abatement may lower the per dollar effectiveness of each enforcement unit. The enforcement curve E^o accordingly shifts to E^1, reflecting the increased difficulty in enforcement. If the productivity of enforcement units is not affected by this new pollutant the curve will not shift. Rather we will see a movement along the curve reflecting the need for more enforcers to force greater abatement expenditures.

By adding to our model information on the cost of employing enforcement units, we can identify total cost of enforcement associated with any number of emitters in the region, any level of air quality, and any set of regulations specifying permissible uses of the air as well as enforcement methods. Figure 5 introduces both the enforcement cost curve, EC, in quadrant III, which merely indicates that the total cost of enforcement increases as one employs more enforcement units, and the enforcement planning curve, EP, in quadrant IV. The enforcement planning curve is derived by tracing through for any number of emitters such as N_1 the associated pollution reduction cost, PR_1, the number of enforcement units needed to ensure that emitters bear these costs, eu_1, to the associated expense of employing these units, EC_1. This tracing gives us one point, labeled a, on the enforcement planning curve. A similar exercise for other numbers of emitters gives the entire enforcement planning curve which indicates the enforcement costs associated with a given set of property rights to clean air in the region as the number of emitters in the region changes.
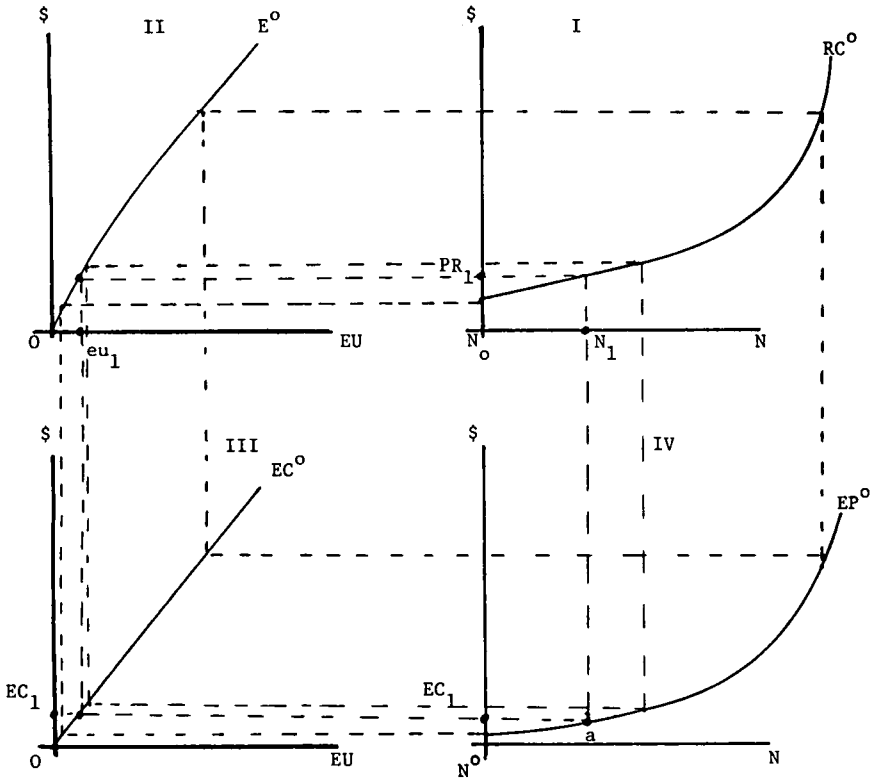
FIGURE 5.   Derivation of an Enforcement Planning Curve.

The enforcement planning curves traced out in Figure 6 reflect the hypothesized impact on enforcement costs of the adoption of a radioactive emissions standard. For instance, for a population of emitters of size N^o at the time of the amendment, the planners take into account an increase in enforcement costs from EC^o to EC^1 as the enforcement planning curve shifts from EP^o to EP^1.

IMPLICATIONS FOR COST-BENEFIT ANALYSIS

At the very least, cost-benefit analysis implies an assurance that the total cost of a project is justified by the beneficial results obtained. When the project under consideration can be varied in size at the policymakers' discretion or when, as in the clean air context, degrees of safety or extent of clean-up can be selected, marginal analysis of costs and benefits provides an assurance that each incremental increase in size or degree of safety or percentage reduction in pollution emitted is cost-justified.
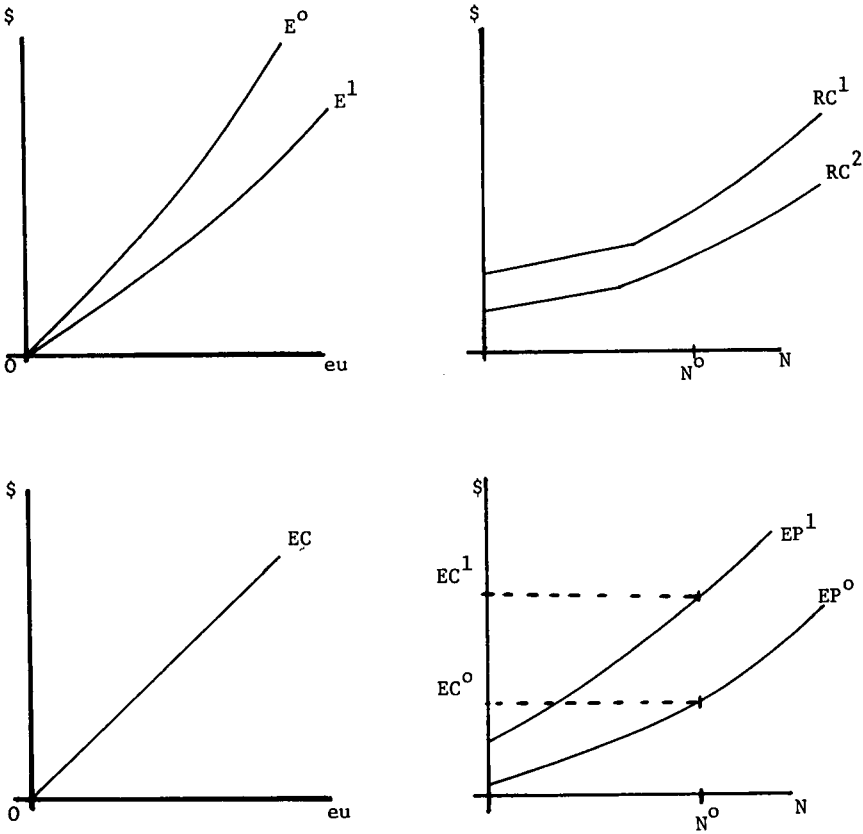
FIGURE 6.   Shift in Enforcement Cost Due to Adopting Radioactive Emissions
             Standard.

Pollution reduction involves three kinds of costs. The emitting firm
bears the cost of obtaining and operating the pollution control devices or
engaging in other production process modification as well as the cost of
certification, inspection, monitoring, and maintenance and other fees.
Budgets of governmental agencies, private organizations, and individuals
bear the costs of the enforcement efforts. The marginal cost of the control
device (MCD) and of the certification and related expenses (MCC) as
well as the marginal enforcement cost (MEC) must all be included in
one's determination of the cost-justified amount of pollution control. The
sum of these marginal costs measures the marginal social cost (MSC) of
increasing pollution reduction through the clean air program. The mar-
ginal social cost is compared to the marginal benefit from incremental
degrees of strictness in standards. Figure 7 depicts marginal curves for
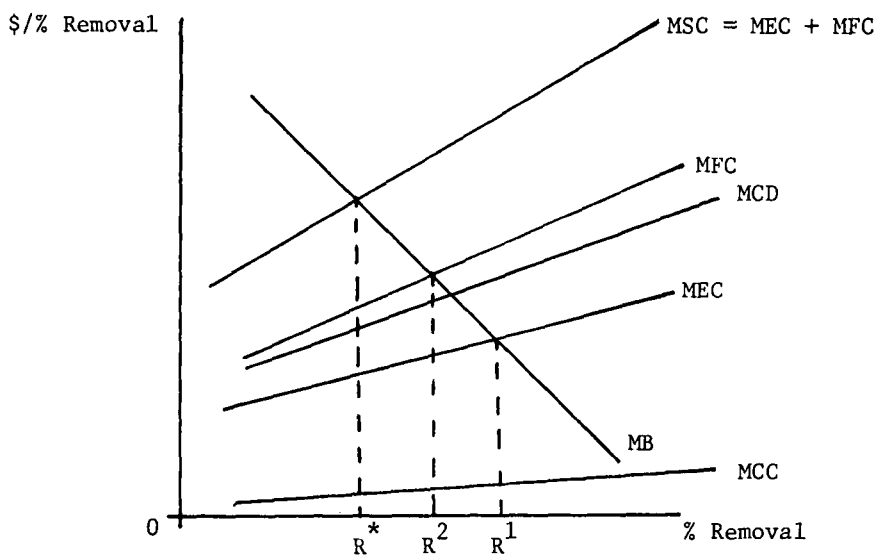
FIGURE 7.   Marginal Analysis of Costs and Benefits Used to Determine the
             Cost-Justified Level of Pollution Reduction.

all of these cost components which rise with each percentage increase in removal of pollutants from emissions, a simple way of summarizing an increase in the level of benefits, and a downward sloping marginal benefits curve, MB. The environmental policy literature recognizes that if any of the relevant costs are ignored the result will be an overestimation of the cost-justified amount of pollution reduction.[50] For instance, if only the marginal costs to the emitting firms (MFC) are included in the computation of the costs of clean air, the appropriate amount of pollution reduction will appear as R^2, which is greater than R^*, the true optimum.

MARGINAL ENFORCEMENT COST ANALYSIS

This article focuses on that portion of costs born by enforcers, seeking to illuminate the sources of these costs inherent in the institutional structure and explain how changes in that structure affect the level of costs. In order to determine the optimal amount of pollution reduction, we can derive a marginal costs of enforcement curve as a function of increased levels of pollution reduction. Quadrant I of Figure 8 depicts the reduction costs curves for various air quality standards. The curves that are higher and further to the left reflect stricter standards of emission reduction which

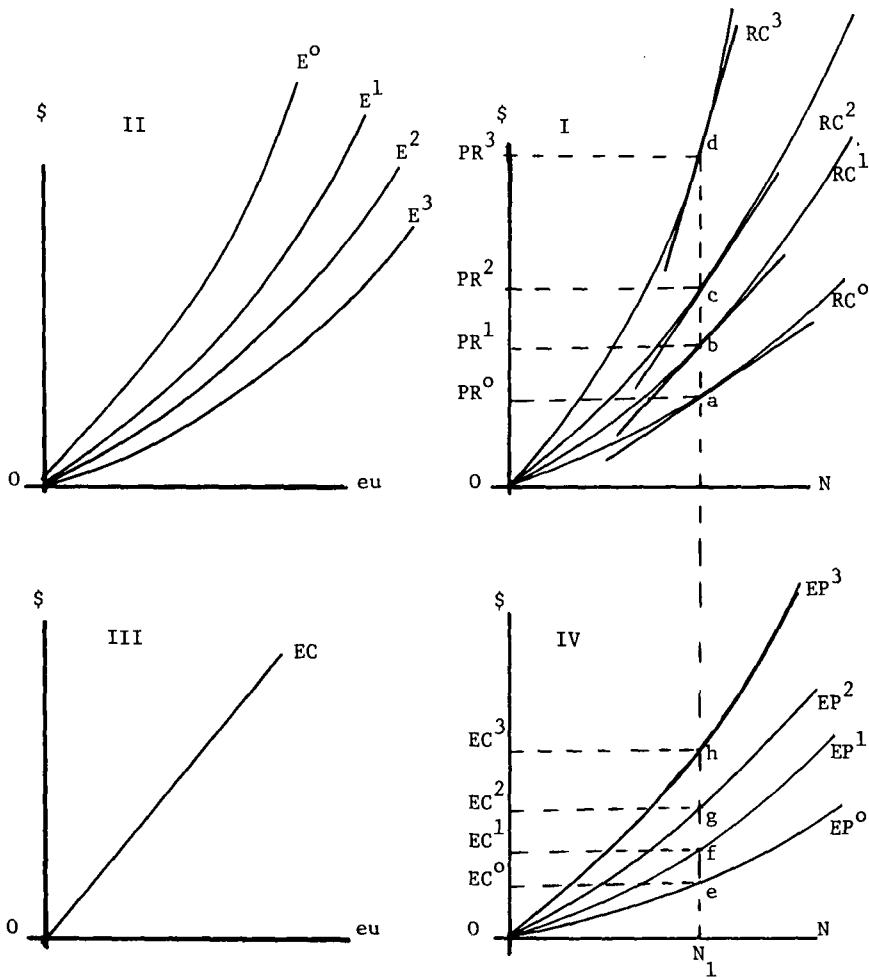---

50. Downing and Watson, *supra* note 26.

FIGURE 8.   Enforcement Planning for Different Benefit Levels.

might be interpreted as greater percentage removal of pollutants from emissions. It is important to note that these reduction cost curves are not to be identified with the total benefit curve from which the marginal benefit curve in Figure 7 was derived. That total benefit curve measures total benefits to all users in an AQCR from varying levels of pollution reduction. Each reduction cost curve in the property rights model describes the cost of providing a fixed level of benefits to each user. We do not derive a total or marginal benefits curve in this analysis; instead, we focus on costs. Quadrant II depicts a family of enforcement curves. Recall that the enforcement curve will shift with changes in the strictness

of standards if the productivity of enforcement units is changed as a result of the new standards. Quadrant III presents the enforcement cost curve, and quadrant IV presents a family of enforcement planning curves associated with increased levels of benefits per person resulting from stricter standards.

Because we wish to compare the effect on enforcement costs of changing the level of benefits without involving other changes, we examine the changes in the level of costs for an AQCR of a given size, N^1. Associated with increased benefit levels B^o, B^1, B^2, and B^3 are total enforcement costs EC^o, EC^1, EC^2, and EC^3. A total enforcement cost curve as a function of the level of benefits (percentage removal) can be drawn as in Figure 9(a) for an AQCR of a given size, N^1. The air quality standard is viewed as getting stricter as one moves further to the right on the abscissa. A corresponding marginal enforcement costs curve, MEC, can be drawn as in Figure 9(b), incorporating the various property rights consideration embodied in the corresponding enforcement planning curves for different benefit levels and fixed number of users in the AQCR. This is the marginal enforcement cost curve needed for determining the cost-justified level of pollution reduction.

MARGINAL POLLUTION REDUCTION COST ANALYSIS

To derive from this model a conclusion with respect to the cost-justified degree of pollution control, we need not only the marginal enforcement cost curve derived above but also a marginal cost curve for the emitters for various levels of benefits in an AQCR of a given size, MFC in Figure 7, and a marginal benefit curve describing gains to breathers of the air from increased air quality standards, MB in Figure 7. The marginal pollution reduction cost to emitters curve, MFC, is derived by plotting the slopes of lines tangent to various reduction cost curves, such as RC^o (B^o), RC^1 (B^1), $RC^2(B^2)$, and RC^3 (B^3) in Figure 8, for an AQCR of emitter size N^1. Figure 10(a) depicts total pollution reduction costs (at tangencies, a, b, c, and d) for an AQCR of size N^1 and benefit levels B^o, B^1, B^2, and B^3. Figure 10(b) depicts the marginal pollution reduction cost curve, MFC, for various levels of air quality in this AQCR.

The marginal benefit curve used in the optimal pollution reduction calculation cannot be derived from the reduction cost curve used in the property rights model without first assigning a unit value to the amount of benefit derived by each individual in an AQCR and associated with a given benefit level. Then these units must be aggregated to produce a total benefit curve. We make no pretense of being able to perform such a task and it is precisely this operation that the Clean Air Act forbids. Our focus has been on the cost side of the issue in order to explain the
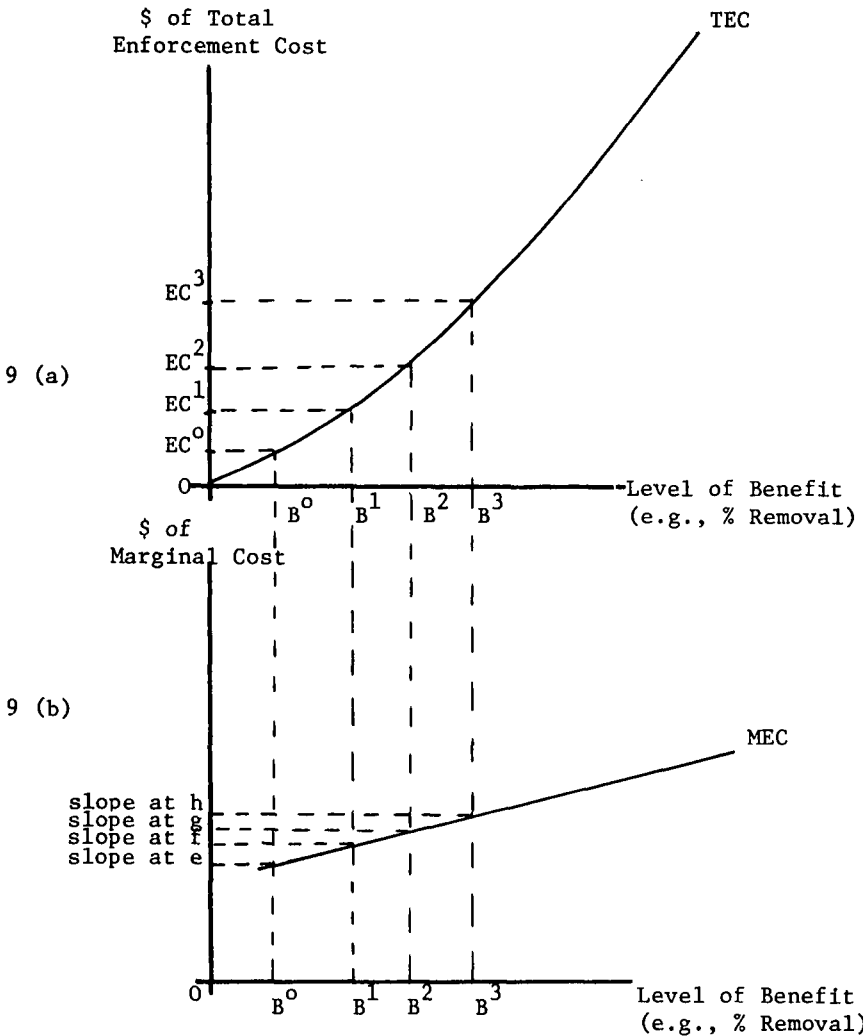
FIGURE 9.   Marginal Enforcement Cost Curve.

interrelationship between levels of benefit and levels of costs so as to enable the planner to evaluate costs associated with policy alternatives. The purpose of deriving the cost curves from the decision model of enforcement costs is to demonstrate how the policymaker can, after having assigned benefit values to various levels of pollution reduction, use enforcement cost information to circumvent the safety-first design of the Act and to enable us to examine the implications of such a circumvention.
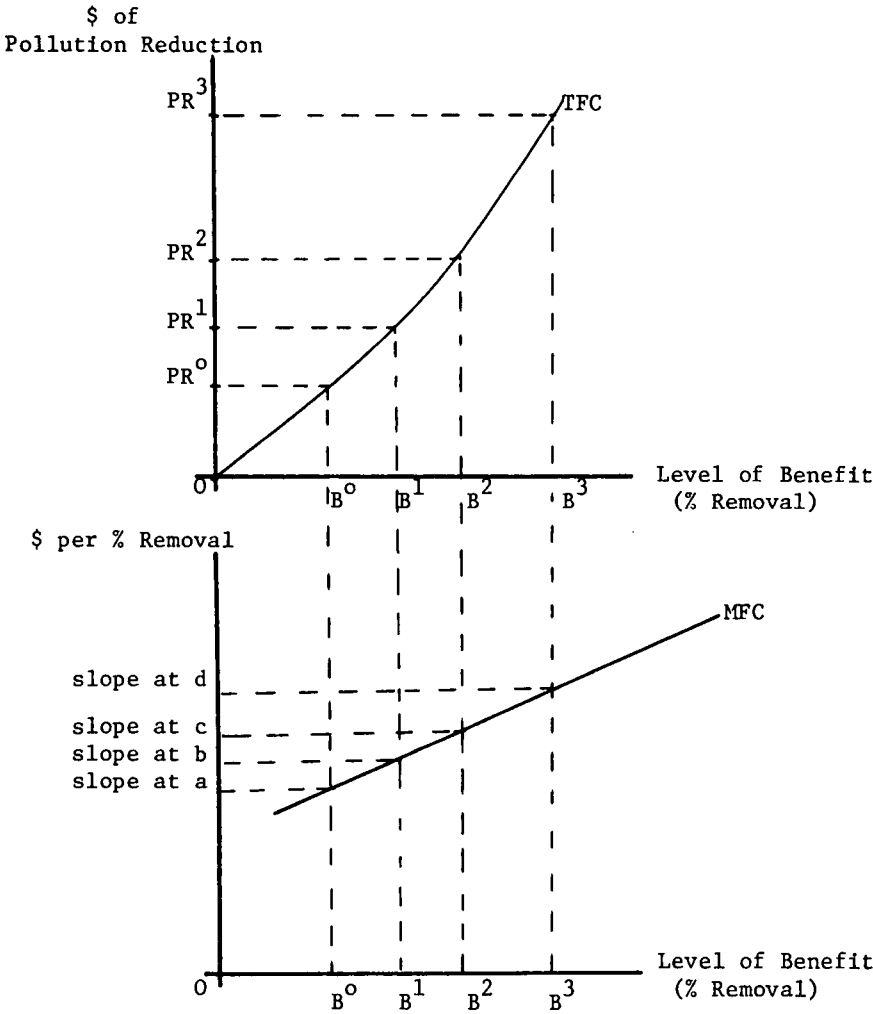
FIGURE 10.   Total and Marginal Pollution Reduction Cost to the Emitting
            Firms.

USING THE ENFORCEMENT BUDGET TO ACHIEVE THE
COST-JUSTIFIED LEVEL OF POLLUTION REDUCTION

The Clean Air Act does not, of course, bind the Congress to providing
sufficient funding to enforce the regulations fully against every violator.
It does provide private citizens with power to compel the administrator
to take certain enforcement actions. This may frustrate the administrator's
desire to enforce selectively. And to the extent that private enforcement

supplants agency enforcement, the agency would be frustrated in its policy of selective enforcement designed to reach a level of air quality lower than that mandated by the national standards but appropriate according to the regulator's perception of the cost-benefit comparison. A safety-first clean air policy carries an implication that standards will be reached whatever the enforcement cost. But the cost-benefit minded policymaker can use enforcement budgeting to take economic costs into account. Reports from environmental enforcers in the current administration suggest that such a policy may currently be in force. Stephen D. Ramsey, chief of environmental enforcement at the Justice Department, stated that the federal enforcement would focus only on cases involving substantial · environmental harm or criminal activity. Such an approach is consistent with the use of budgetary constraint to reach the cost-justified level of pollution reduction. The implications of such an approach are outlined in this section.

THE MINIMALLY COST-CONSCIOUS REGULATOR

From the perspective of enforcement costs alone, the regulator of air quality may wish to halt enforcement before the air is perfectly clean. Even a minimally cost conscious administrator may desire to curtail enforcement at the point where the additional cost of preventing another violation of emissions regulations exceeds the incremental benefit from achieving compliance. If the regulator applies each enforcement team where it will produce the most pollution reduction, the point beyond which declining incremental benefits from additional enforcement are exceeded by the cost of that enforcement is at the percentage removal of pollutants indicate by R^1 on Figure 7.

The regulator's strategy for quantifying the incremental benefit from additional enforcement is a complex one because it depends on the emitters' responses to the regulator's enforcement techniques. The interaction of the two parties' strategies presents a problem similar to that confronted in the economics literature describing the pricing strategy of two firms sharing a duopoly market.[51] Driven by the profit maximization as a goal, the price of each firm's output will depend on the other firm's price. Each firm would like to wait until the other is committed to a price before committing itself but cannot wait because customers must be told a price. To set a price and then to respond in the next round of price setting, each firm manager must make some assumptions about the other firm manager's behavior in order to obtain the highest possible profit. The analogy

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51. *See* FRITZ MacLUP, THE ECONOMICS OF SELLER'S COMPETITION 368–413 (1952) (an analysis of early duopoly models and later theoretical developments).

between these responses and the confrontation between regulator and regulated is a close one. To identify considerations involved in examining these strategies, the parties' incentives must be examined.

The emitter who is required by regulation to produce pollution abatement in actuality has two choices, to comply with those rules or to violate them. Assuming that the emitter will follow the least cost alternative, the emitter will combine the two alternatives in some way. A model describing emitters' incentives has been developed by Downing in his papers with Watson[52] and Kimball.[53] The thrust of their approach is that firms seek to minimize the sum of expected costs of control devices and of expected costs of compliance and enforcement actions imposed on the firm under a given set of control regulations or, as it is referred to in this article, a given property rights assignment. The cost of control devices includes all of the components measured on the vertical axis of the reduction cost curve—capital and installation costs as well as operation, maintenance, monitoring, and certification costs. The expected compliance cost is a function of the number of violations detected by the enforcers times the penalty per violation.

Downing and others view the number of detected violations as a function of several components. These are the expected control efficiency of the device installed by the firm in response to a given set of rules and regulations imposed by the control agency and/or the legislature, the relevant conditions being the frequency, accuracy, and form of the inspection and monitoring actions of the control agency; the emission standard set by the control agency; and the requirements set by the control agency for certification of the effectiveness of the firm's control device.[54]

The expected penalty is a function of the probability of being convicted of a violation (which depends on the legal costs incurred by the firm in defending its claim weighted by the effectiveness of such firm's reputation) and the possible shutdown time for required repairs or installation of equipment.[55] To this we might add the dollar value of jail time for corporate officers convicted of knowing violations under Section 7413(c) of the Clean Air Act, the opportunities foregone as a result of being denied government contracts under the procurement provisions of Section 7606, and possible delays resulting from the nonattainment rules prohibition against commencing construction of a new major emitting facility

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52. *Id.*
53. Enforcing Administrative Rules: The Case of Water Pollution Controls (Presented at National Bureau of Economic Research Conference on Public Regulation, 1978) and Enforcing Environmental Regulations, Working Paper No. CE-77-3-3 (Center for Study of Public Choice, V.P.I, and S.U., Blacksburg, Va.)
54. *Id.*
55. *Id.*

while another source owned or operated by the same party is not in
compliance under Section 7503. We might predict that, *ceteria paribus,*
if the cost of compliance increased, more violations would occur. The
increase in violations would require an increase in the number of en-
forcement units needed to enforce fully the regulations for any given level
of air quality.

For a given set of property rights and behavior by the enforcers, the
firm can adapt its behavior to minimize costs. The enforcement agency,
for a given set of property and adaptive behavior of the firm, can also
minimize its costs, which include both enforcement expenditures and the
harm resulting from violations. Downing's model predicts the behavior
of the firm as a reaction to the enforcer's strategy of enforcement. The
behavior of the enforcer will depend on the emitters' responses to reg-
ulatory requirements, a *violations function* which in the Clean Air Act
context describes the firm's compliance strategy. There are at least as
many solutions to the indeterminacy suggested by the interdependence
of decisions of enforcers and emitters as there are models of duopoly
behavior in the economics literature. The rational enforcer and emitter
will seek knowledge of the other's behavior in order to determine their
own strategy.

Generally we know that the minimum cost position of the firm and the
enforcer respectively is a function of, by analogy to the duopoly situation,
the output of the other. The output of the firm is noncompliance while
the enforcer's output is enforcement teams. One plausible assumption is
that the enforcer and firm follow the leadership/follower model of Stack-
elberg.[56] In this case, the emitter minimizes its expected costs of control
assuming that the overall enforcement policy of the enforcer, i.e., in
Downing's model, the frequency, accuracy, and form of inspection, the
strictness of compliance tests, and the diligence of pursuing perceived
violations, is invariant with respect to the degree of compliance by the
one firm. This leads to a determinate solution to the conflicting strategies
of the parties.[57]

Understanding the compliance strategy or violations function of the
emitters allows the minimally cost-minded regulator to adjust accordingly

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56. HEINRICH VON STACKELBERG, MARKTFORM AND GLEICHGEWICHT (1934).

57. Given a set of property rights and market and scientific and technical parameters defining the
level of capital and maintenance cost, control device efficiency, emissions standards and penalties
(including fines and damage from down time and to public image), the enforcement effort of the
enforcer is the relevant parameter to which the firm must adjust. The functions describing for each
firm the optimal reaction to any given enforcement strategy by the enforcer make up the violations
function referred to above. Because the decisions of the enforcer now depend only on its own
enforcement effort, the violations by the firms being expressed as a function of this degree of
enforcement, the goals of the agency can be maximized with respect to this single variable. The
enforcer assumes that the firms act as followers and maximizes its goals given the violations functions
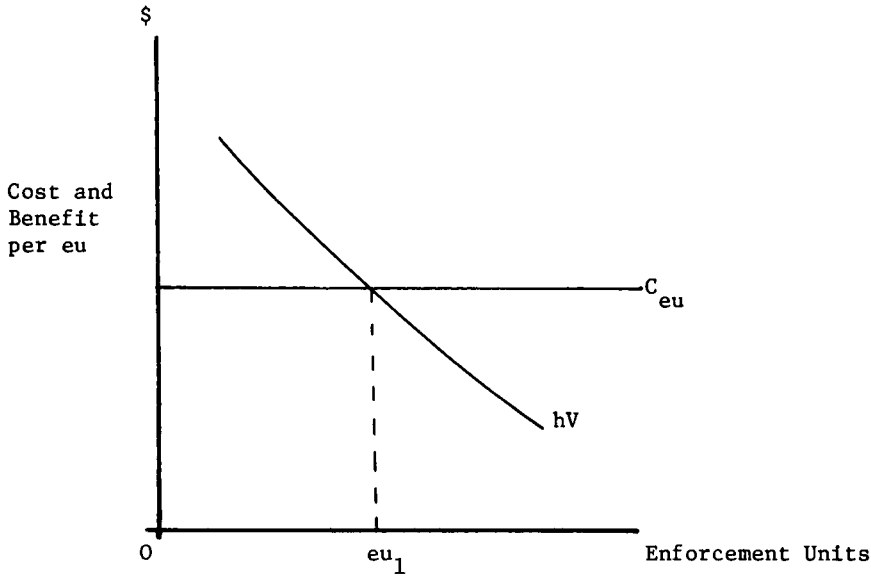of the firms.

FIGURE 11.   Enforcement Strategy for the Minimally Cost Conscious Regulator.

the number of enforcement units employed. The benefit from enforcement is prevention of a violation and its associated harm to health and safety. Figure 11 describes this adjustment by reference to both the cost of employing enforcement units, assumed to be a constant dollar cost per enforcement team, C_{eu}, and the benefit associated with preventing violations and their associated harms, hV. The incremental benefits curve, hV, declines as more enforcement teams are employed because we assume that enforcement is applied first to those situations where enforcing compliance will give the greatest benefit. To the right of eu_1 on Figure 11, the employment of additional enforcement teams is not justified by the resulting benefits. Note that this strategy allows some violations to occur and the air will be of a quality lower than that dictated by the safety-first national air quality standards. This is all based on an assumption that the regulator feels that the safety-first national air quality standard would not be justified by a cost-benefit analysis.

THE RIGOROUSLY COST-CONSCIOUS REGULATOR

The strategy described above will not satisfy the rigorously cost-minded regulator who seeks a level of benefits justified on a full cost rather than just an enforcement cost basis. Working with the enforcement budget to hire even fewer enforcement teams, this lower degree of compliance and
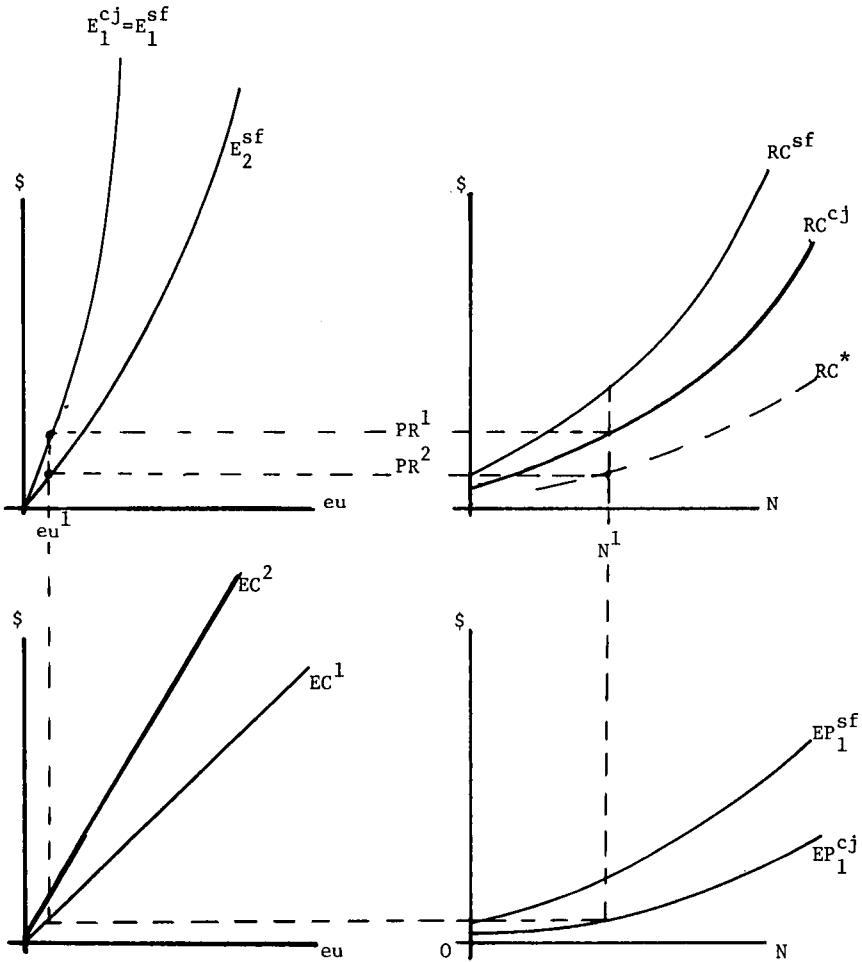
FIGURE 12.   Implications of Back Door Cost-Benefit Analysis.

resulting lower air quality and lower reduction cost can be achieved. By reference to the cost-justified standard, the enforcement planning model indicates a level of enforcement of the safety-first standard that will approximate the cost-justified result.

Quadrant I of Figure 12 describes two reduction cost curves, one for each of two air quality standards, continuing the assumption that the regulator concludes that the safety-first standard, reached at costs indicated by RC^{sf} for different numbers of emitters in an AQCR, is not cost-justified. The cost-justified standard is achieved at reduction costs indicated by RC^{cj}. For a given set of regulations designed to achieve the

respective standards, enforcement planning curves EP^{sf} and EP^{cj} can be derived by tracing through the associated enforcement curves and enforcement unit cost curves. For a given number of emitters in the region, the rigorous cost-minded regulator, having determined that standard "cj" is cost-justified by reference to the costs of compliance as well as the costs of enforcement, recognizes an associated enforcement cost of EC^1. Hoping to induce an expenditure by emitters of PR^1, the regulator employs eu_1 enforcement teams. If the enforcement curves for the two standards are identifical, i.e., $E^{sf} = E^{cj}$, as shown, the regulator will in fact induce this expenditure. Under what conditions will E^{sf} be identical to E^{cj} and, even if they are identical, will an expenditure of PR^1 give the desired cost-justified air quality if the actual published standard is the safety-first standard? Given that enforcement strategy is a policy not clearly prohibited by the statute, and one likely to be pursued by an administration seeking cost-justification for a safety-first regulation, answers to these questions point up the weakness in adopting this back-door cost-benefit analysis instead of restructuring those provisions of the Act that prohibit such criteria in establishing national standards.

IMPLICATIONS OF BACK-DOOR COST-BENEFIT ANALYSIS

Such back door cost-benefit analysis may be undesirable even from the point of view of the rigorously cost-minded regulator. While it may be the best the regulator can do given public support for a safety-first Clean Air Act, the outcome may not be a good approximation of the cost-justified level. The similarity of outcome will depend on the difference between the regulations such as performance and specification standards needed to reach the safety-first standard, and those needed to reach the cost-justified standard, as well as the relative efficiency of enforcement teams in enforcing compliance with the associated regulations.

Consider first the differences in enforcement. The derivation of enforcement planning curves in Quadrant IV of Figure 12 assumed that the enforcement relations E_{sf} and E_{cf} were identical for the two standards. Section I above, however, described how a change in the pollution reduction requirements promulgated as regulations can result in a shifting of the enforcement curve. Refer to Figure 4 as an example. To reach the higher safety-first standard, the regulations might specify greater percentage reduction of a particular pollutant from smokestack emissions. If building taller stacks was sufficient to reach the percentage removal requirement needed to meet the cost-justified standard but a more expensive scrubber technology is needed to meet the safety-first requirement, then the reduction cost curve for the higher benefit level implicit under the safety-first standard would be above the reduction cost curve

under the cost-justified standard, as shown in Figure 12, quandrant I. If it is more difficult to detect and prove inadequate application of the scrubber technology than to certify that tall stack dispersion of pollutants is occurring, then the enforcement curve for the safety-first standard will be below and to the right of the curve for the lower standard. As shown in Figure 12, the enforcement curve for the safety-first standard, E_2^{sf}, implies less efficient enforcement. As a result, instead of inducing pollution reduction expenditure PR_1, only PR_2 is induced and only the less than cost-justified level of benefits, indicated by another cost curve such as RC*, is achieved. It is quite possible, of course, that the requirement of technology that eliminates a higher percentage of pollutants will be easier to enforce, in which case a higher amount of pollution reduction will result. From the point of view of the rigorously cost-conscious regulator this is not a desirable outcome because more expenditure on pollution reduction is occurring than is justified by its associated benefit. Analogous results are obtained when, instead of raising removal requirements for a controlled pollutant, the Congress or EPA requires abatement of a new pollutant, such as radioactive pollutants, or changes definitions of which emitters are subject to "major pollution source" controls.

A departure from the cost-justified outcome will also occur if the regulation under the higher standard requires a different and more expensive type of enforcement team, such as specialists in the interaction of radioactive particles. In addition to a new enforcement relation, each unit of enforcement is, in such a situation, more expensive, as indicated by a shift in the enforcement cost curve EC^1 to EC^2 in Figure 12. For what appears to the rigorously cost-conscious regulator as a cost-justified enforcement budget, less pollution reduction is induced than is justified. This suggests that a difference in the means for achieving respective air quality standards is crucial to reaching a cost-justified result through control of the enforcement budget.

In addition to these problems, the pollution reduction technology required by regulations promulgated under the safety-first standard might differ from the technology that would be selected by a regulator who was able to be explicit about reaching the lower cost-justified air quality standard. This difference means that the air quality resulting from an enforcement budget restrained, safety-first approach will diverge from the air quality resulting from an explicitly cost-justified approach. Imperfect enforcement of a safety-first technology that induces pollution reduction expenditures of $1 billion may result in lower air quality than perfect enforcement of a cost-justified technology that induces an equal expenditure. As a result of the subterfuge of back door cost-benefit analysis, a less efficient technology for pollution reduction is used resulting in less pollution reduction per dollar expended. Another subterfuge, one

that may be easy to conceal from public opinion, is to promulgate reg-
ulations requiring abatement that the regulator might claim is designed
to achieve the safety-first standard but which, in application, can reach
only the cost-justified level. Provisions of the Clean Air Act requiring
use of the best available system of continuous emissions reduction, taking
into account the cost of achieving such emission reduction,[58] make it
easier for the rigorously cost-minded regulator to engage in this subter-
fuge, thereby enhancing the regulator's ability to aim for the cost-justified
level of pollution reduction.

CONCLUSION

The Clean Air Act does not permit explicit cost-benefit analysis in
setting standards for air quality. Concern for over-regulation, however,
may lead the current or future administrations or regulators to seek a
method for reducing the costs of regulation to what they perceive to be
cost-justified levels. Assuming that this cost-justified level is lower than
the safety-first level of air quality described by the Clean Air Act, a cost-
conscious regulator, whether a representative of the executive branch,
the EPA Administrator, or the Congress, may try to contain cost by being
lenient with emitters. One way of interpreting leniency is to change
regulations so that the higher safety-first level of air quality is never
reached. This is discouraged to a certain extent by the safety-first re-
quirement of the Act itself and also by public opinion which appears to
favor strict air quality standards.[59] An alternative approach for the reg-
ulator is to be lenient in enforcement by cutting back the enforcement
budget so as to induce an investment in pollution reduction that is justified
by the regulator's perception of associated benefits. Problems with this
approach, tempting though it may be to the cost-conscious regulator, lead
to an imperfect approximation of the cost-justified standard. When safety-
first standards require technology different from technology that would
be chosen under a cost-justified standard, when the associated enforce-
ment process is different and enforcement teams are less efficient at
inducing pollution reduction expenditures under the higher standard, when
more expensive enforcement technologies are required to enforce the
higher standard, less investment in pollution reduction might occur and
air quality might be lower than the cost-justified target. Given the presence
of a cost-minded administration, society might be better off with explicit
cost-benefit analysis in setting the air quality standards from the start and
abandoning as giving an inferior result the safety-first approach.

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58. 42 U.S.C. § 7411(a)(1)(C)(Supp. I 1977).

59. According to a survey by the Lou Harris organization, a large marjority of Americans supported
the current provisions of the Clean Air Act. By 86% to 12%, those surveyed oppose making the Air
Act less strict. Thirty-eight percent of those surveyed wanted to make the Air Act stricter. [12 Current
Developments] ENV'T REP. (BNA) 280–81 (June 26, 1981).