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Regulation, Innovation, and Administrative Law: A Conceptual Framework

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Lagging U.S. productivity growth has become a major concern. From 1947 to 1966, the average annual rate of increase in the U.S. private sector output of goods and services per hour of labor input was 3.44%. From 1973 to 1978, the rate of increase fell to 1.15%.[1] Because productivity increases represent the economic dividend that can increase consumer purchasing power or government spending, this drop has profound social and political implications domestically and for the U.S. position in the international economy. Although average U.S. productivity remains the highest in the world, many other nations, most notably Japan and West Germany, have recently shown substantially higher productivity growth, particularly in key industries such as steel, automobiles, and electronics.[2]

A massive expansion of federal environmental, health, and safety regulation coincided with the decline in U.S. productivity growth during the 1970's. Critics of regulation assert that the two developments are causally related. They contend that regulatory costs, constraints, delays, and uncertainties have hindered investment in new products and industrial plants and diverted scarce capital to unproductive uses.[3]

This simplistic correlation grossly exaggerates the adverse impact

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1. During 1966-73, the figure was 2.15%. SENATE COMM. ON COMMERCE, SCIENCE, AND TRANSPORTATION AND JOINT ECONOMIC COMM., ENVIRONMENTAL AND HEALTH/SAFETY REGULATIONS, PRODUCTIVITY GROWTH, AND ECONOMIC PERFORMANCE: AN ASSESSMENT, 96th Cong., 2d Sess. 11 (Comm. Print 1980) (prepared by G. Christiansen, F. Gallop, and R. Haveman) [hereinafter referred to as HAVEMAN REPORT].

2. *See* NATIONAL RESEARCH COUNCIL, TECHNOLOGY, TRADE AND THE U.S. ECONOMY (1978); Neef & Capdeville, *International Comparisons of Productivity and Labor Costs*, MONTHLY LAB. REV., Dec. 1980, at 32 (U.S. Bureau of Labor Statistics, Dep't of Labor).

3. *See, e.g., The Cost of Government Regulation: Hearings Before the Subcomm. on Economic Growth and Stabilization of the Joint Economic Comm.*, 95th Cong., 2d Sess. (1978); Weidenbaum, *Government Power and Business Performance*, in THE UNITED STATES IN THE 1980's, at 205-10 (P. Duignan & A. Rabushka eds. 1980); N.Y. Times, Feb. 25, 1981, § A, at 26, col. 1 (reporting on President Reagan's message to Congress in which he said: "American society

of regulation. The basic purpose of environmental, health, and safety regulation is to reduce harmful "externalities" generated by an industrialized market economy. Productivity measures reflecting only market-based values ignore many social benefits created by health and safety regulation, and thus understate the real performance of the economy during the 1970's.[4] Moreover, the available evidence indicates that factors other than regulation, including macroeconomic policy, changing work force composition, and energy prices have been the major causes of productivity lag.[5] Nonetheless, regulation undoubtedly has had an adverse effect on investment in new plants and products. This fact, coupled with the apparent correlation between regulatory initiatives and sharply reduced productivity, has generated demands that government relax regulatory programs.

Proponents of less stringent regulation also charge that in addition to hampering productivity, environmental, health, and safety regulatory programs often have failed to meet their own stated goals. From 1970 to 1980, for example, statutory deadlines for achieving air and water pollution control objectives have been repeatedly postponed, and some pollution problems have worsened.[6] Massive increases in the production of broad-scale chemical pesticides have undermined the effort to develop more environmentally sound and effective means of pest control.[7]

These shortfalls are attributable in part to the failure of existing regulatory strategies to stimulate development and adoption of environmentally superior technologies. "Social innovation," which could include, for example, the development of "clean" automobile engines, less polluting, safer industries, and environmentally superior pest control methods, has fallen short of what is needed to meet ambitious goals for improved social performance. From a longrun perspective, such innovation is needed just to prevent matters from getting worse. If economic growth continues, pollution and other forms of harmful externalities will also increase unless society continually develops and

experienced a virtual explosion in government regulation during the past decade. . . . The result has been higher prices, higher unemployment and lower productivity growth.")

4. *Cf.* A. FREEMAN, THE BENEFITS OF ENVIRONMENTAL IMPROVEMENT (1979) (discussing ways to measure benefits of regulation).

5. *See* text accompanying notes 97-103 *infra*.

6. *See, e.g.*, R. STEWART & J. KRIER, ENVIRONMENTAL LAW AND POLICY 432-36, 501-05, 532-35 (2d ed. 1978) (deadline postponements); Comment, *The Clean Air Act: A Realistic Assessment of Cost Effectiveness*, 5 HARV. ENVT'L L. REV. 184, 185 (1981) (increases since 1970 in emissions of oxides of nitrogen).

7. Domestic and export sales of pesticides by United States manufacturers increased from $638,984,000 in 1967 to $3,369,765,000 in 1978. THE CONSERVATION FOUNDATION, PRODUCT REGULATION AND CHEMICAL INNOVATION C-8 (March, 1980) (OTA Report) [hereinafter cited as CONSERVATION FOUNDATION].

adopts improved technologies that reduce the externalities generated per unit of output.[8]

Two key aspects of innovation and investment accordingly deserve attention in environmental, health, and safety regulation: market innovation and social innovation. Market innovation encompasses development and adoption of new products and processes that will increase market measures of output per unit of labor or other input and thus increase productivity as measured by traditional national income accounting. Social innovation includes the development and adoption of new products and processes that are less polluting and safer or that otherwise deliver improved social performance, thereby facilitating the underlying goal of environmental, health, and safety regulation.

This Article addresses the interaction between regulation[9] and innovation from the perspective of administrative law, focusing on regulatory tools, institutional arrangements, and government decisional processes. It concludes that productivity problems do not justify abandoning environmental, health, and safety goals. However, it also finds that existing command-and-control regulatory tools must be modified or replaced in order to reduce adverse impacts on market innovation and to provide incentives for social innovation.

Part I summarizes the principal characteristics of the current regulatory system. Part II develops a conceptual framework describing the

8. Changing patterns in consumption in response to changes in relative prices and changing preferences may also reduce spillovers per unit of output. Pollution, for example, is disproportionately associated with basic materials processing, such as nonferrous smelting and steelmaking. As the United States produces relatively more services than durables, as raw materials resource prices rise, and as consumers perhaps shift preferences away from consumption of large cars, spillovers generated per unit of average output will fall. But in most cases these factors alone will likely be insufficient to offset the absolute growth in output.

9. This Article is limited to the following fields of regulation: (1) product regulation of the chemicals subject to control under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. §§ 136-136y (1976), *as amended by* Federal Environmental Pesticide Control Act of 1972, Pub. L. No. 92-516, 86 Stat. 973 (1972), and Federal Pesticide Act of 1978, Pub. L. No. 95-396, 92 Stat. 819 (1978); and the Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601-2629 (1976); (2) air and water pollution regulation of industrial processes subject to control under the Clean Air Act (CAA), 42 U.S.C. §§ 7401-7626 (Supp. III 1979), *as amended by* the Clean Air Act Amendments of 1977, Pub. L. No. 95-95, 91 Stat. 685 (1977); and the Federal Water Pollution Control Act (FWPCA), 33 U.S.C. §§ 1251-1376 (1976), *as amended by* Clean Water Act of 1977, Pub. L. No. 95-217, 91 Stat. 1566 (1977); and (3) product regulation of various aspects of motor vehicle performance: air pollution under the CAA; safety under the National Traffic and Motor Vehicle Safety Act of 1966 (NTMVSA), 15 U.S.C. §§ 1381-1431 (1976); and fuel economy under the Energy Policy and Conservation Act (EPCA), Pub. L. No. 94-163, 89 Stat. 871 (1975) (fuel economy standards are codified in 15 U.S.C. §§ 2001-2012 (1976), amending the Motor Vehicle Information and Cost Savings Act, 15 U.S.C. §§ 1901-2012 (1976)).

This Article focuses on federal law. With limited exceptions, the regulation of chemicals and automobiles is a function of federal law. Industrial processes, on the other hand, are subject to much more state and local environmental regulation. However, this regulation will not be considered except where it interacts with federal law to create multiple licensing requirements or where it provides a potential alternative to present systems of centralized regulation.

relationship between regulatory tools and decisional processes on the one hand and market and social innovation on the other. It identifies the characteristics of regulation that most significantly affect both social and market innovation: compliance costs, technical constraints that foreclose innovation opportunities, and the delay and uncertainty associated with determining regulatory requirements. Part III uses this conceptual framework to assess the consideration given to innovation in current regulatory programs and the impact of those programs on both market and social innovation. It concludes that Congress and administrators have generally displayed little or no concern with the impact of regulation on market innovation, but instead have emphasized enforceability, uniformity, and avoidance of disruption.[10] Further, Part III concludes that although Congress has shown more concern over the impact of existing programs on social innovation than on market innovation, that subject also has not received adequate study, and that regulatory programs have in many respects failed to achieve "technology-forcing" goals of stimulating the invention of new, environmentally superior products and processes. Part IV identifies modifications and alternatives to the current regulatory system that could improve its performance in fostering market innovation and social innovation[11] and argues that, contrary to the popular conception, the objectives of improved social performance and increased investment in innovation are often complementary and that policy choices do not inevitably involve a "zero-sum game" trade-off between environmental goals and market outputs. Part V recommends four modifications to the current regulatory system that could improve both market and social performance. In order of increasing ambition and scope, they are (1) procedural and institutional steps to encourage greater consideration of innovation impacts by regulatory agencies, (2) modification of current

10. Arguably, innovation as such should not be a concern in the design and implementation of regulatory programs. If programs were designed to achieve worthy social goals in a cost-effective way, market productivity problems might be entirely solved through macroeconomic, tax, and labor policies. *See* HAVEMAN REPORT, *supra* note 1, which suggests that the key to market productivity lies in macroeconomic, tax, and labor policy. There are, however, political and practical limits on the extent to which macroeconomic and tax policy can promote productivity growth. Moreover, many burdens of regulation consist of hard-to-measure opportunity costs related to constraints, delay, and uncertainty. In theory, a cost-effective regulatory strategy would minimize all compliance costs, including the opportunity costs described above and compliance outlays. In practice, these opportunity costs are difficult to measure and are likely to be disregarded or downplayed, as the history of current regulatory systems indicates. *See* text accompanying note 106 *supra*. Because of the substantial impact of opportunity costs on market innovation, a program of regulatory reform aimed at promoting innovation—as opposed to cost effectiveness in general—is more likely to reduce such costs and promote innovation.

11. For a discussion of the problems in matching regulatory tools and regulatory objectives, see Breyer, *Analyzing Regulatory Failure: Mismatches, Less Restrictive Alternatives, and Reform*, 92 HARV. L. REV. 547 (1979).

regulatory tools, (3) promotion of decisionmaking procedures other than adversary litigation, and (4) adoption of decentralized economic-based incentive systems as an alternative to or supplement to traditional command-and-control regulation.

I
THE CHARACTERISTICS OF THE CURRENT REGULATORY SYSTEM

A. Regulatory Tools

The basic justification for environmental, health, and safety regulation is preventing or reducing harmful spillovers or externalities such as pollution generated by producers and consumers in a market economy.[12] Because the costs of such spillovers are mainly borne by others, those generating the spillovers do not have an economic incentive to prevent or reduce them.[13] Spillovers typically affect many individuals—each of whom has a relatively modest stake in solving the problem—and involve uncertain risks of harm. Spillover reductions have a "collective good" character because of their typically nonexcludable nature; it is generally impossible to benefit one person by improving air quality without simultaneously benefiting all other affected individuals. As a result, transaction costs and "free-rider" problems discourage persons affected by a harmful externality from banding together to pay spillover generators to reduce the spillover.[14]

In theory, common law doctrines of nuisance, negligence, and trespass could be invoked by spillover victims either to enjoin the generation of spillovers or to win damage awards that would give the generators an economic incentive to reduce spillovers. In practice, however, the difficulties of coping with multiple and uncertain causation in case-by-case litigation, the expense of litigation, and the limita-

12. The perception that environmental, health, and safety problems are caused by industry or consumer generated externalities, see R. STEWART & J. KRIER, *supra* note 6, at 107-16, implicitly assigns victims of hazards an entitlement to be free of such hazards. Kennedy, *Cost-Benefit Analysis of Entitlement Problems: A Critique*, 35 STAN. L. REV. 387 (1981).

13. Employers have an incentive to reduce workplace hazards where employees know of such risks and demand increased compensation for them. But proponents of occupational health and safety regulation have questioned how much employees know about hazards and how much bargaining power they can muster to achieve their reduction. N. ASHFORD, CRISIS IN THE WORKPLACE 335-38, 363-65, 373-76 (1976).

The justification for regulating automotive fuel economy must lie in externalities such as the national security implications of oil import dependence or the need to offset the impact of regulations that have held the price of gasoline below market levels.

Automobile owners have some market-based incentives to purchase safer cars: they want to avoid accidents and reduce insurance costs and expected liability damages to others. However, knowledge of auto safety benefits may be scanty, and the incentives provided by insurance and liability systems are imperfect.

14. *See* R. STEWART & J. KRIER, *supra* note 6, at 99-117.

tions of class action devices have severely limited the ability of private litigation to provide adequate incentives to reduce broad-scale spillovers by multiple sources.[15]

Because the market has not generated adequate incentives to reduce spillovers and to provide collective goods such as clean air, and because private litigation has proven an inadequate remedy, legislators have created administrative agencies and programs in an effort to solve spillover problems.[16]

The present system of administrative remedies relies almost exclusively on "command-and-control" measures that require or proscribe specific conduct by regulated firms. Commands are enforced through orders, injunctions, civil penalties, and criminal fines. Regulated firms generally are not permitted to deviate from specified conduct by paying fees proportionate to the degree of noncompliance.[17] In contrast to command-and-control measures, a system of market-based alternatives, such as emission fees or transferable pollution permits, would in theory provide continuing economic incentives for improved social performance but allow firms flexibility in responding to those incentives.

Congress relies on command-and-control rather than market-based incentives for several reasons. First, the system is well-developed and reflects considerable operational experience.[18] Second, the impetus for government intervention in environmental and health matters is often the prevention of serious harm which command-and-control can assure.[19] Third, in order to generate the political support necessary to push through new legislation, legislators, with the aid of the media, often indict the firms sought to be regulated for irresponsible or immoral conduct. The moralistic basis for regulatory initiatives finds nat-

15. *See id.* at 198-324.

16. The notion of "market failure" serves useful expositional and heuristic purposes by pinpointing the structural deficiencies of market institutions and private litigation in coping with spillovers. Its use here, however, should not imply any normative commitment to a market allocation of resources or to the view that government measures should strive for the allocation that would be achieved if the market did not "fail."

17. In practice, the probability and severity of sanctions may depend on the degree of noncompliance and on whether the violation is the first offense. *See* Roberts & Farrell, *The Political Economy of Implementation: The Clean Air Act and Stationary Sources*, in APPROACHES TO CONTROLLING AIR POLLUTION 152, 166 (A. Friedlander ed. 1978).

The fuel economy provisions of the Energy Policy and Conservation Act, *see* note 9 *supra*, and certain motor vehicle provisions of the Clean Air Act as amended in 1977, *see id.*, authorize noncompliance fines proportional to the degree of noncompliance. 15 U.S.C. § 2008(b) (1976); 42 U.S.C. § 7525(g) (Supp. III 1979).

18. By contrast, there has been little or no working experience with economic incentives; the extent to which such alternative systems will change behavior is typically more uncertain. Moreover, these systems may be perceived as implicitly condoning antisocial conduct by providing a "license to pollute."

19. The tradition also may reflect the dominance of lawyers and legalism in policymaking. A. KNEESE & C. SCHULTZ, POLLUTION, PRICES AND PUBLIC POLICY 116-17 (1975).

ural expression in command-and-control prohibitions. Fourth, recent regulatory legislation reflects a deep distrust, not only of the firms regulated, but of state and federal administrators responsible for implementing such legislation. The use of a highly centralized system of command-and-control regulation allows environmental advocacy groups, unions, and other representatives of regulatory beneficiaries to police their administration by challenging inadequate agency implementation in the courts or by enforcing regulatory requirements directly through "citizen suits" against regulated firms.[20] For these reasons, Congress has until recently paid little attention to market-based incentive systems, despite their potential advantages over command-and-control regulation in fostering innovation.

The broad category of command-and-control regulation incorporates a variety of approaches and techniques, which Congress and administrators tailor to the nature of the product or process regulated, to the potential for conspicuous regional or local disruptions, and to the need to minimize decision costs and survive legal challenges. The following sections describe the major characteristics of command-and-control regulation in the environmental, health, and safety context.

1. Standards vs. Screening

Regulations governing firms' conduct can be expressed either in general requirement standards uniformly applied to an entire category of products or processes (standards) or through "hand-tailored" individual determinations (screening). Screening is commonly used when regulators find it difficult to express and measure the performance or characteristics of a product or process in standardized terms or when many different factors must be assessed.[21] Standards often are made

20. *See* R. STEWART & J. KRIER, *supra* note 6, at 642-60.

21. The new-source performance standards issued under the Clean Air Act, 42 U.S.C. § 7411 (Supp. III 1979), and the effluent limitations issued under the Federal Water Pollution Control Act, 33 U.S.C. § 1312 (1976), are examples of standards. Decisions to grant or cancel the registration of a particular pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. § 136a (1976), are examples of screening. In practice, most regulatory decisions combine uniform standards and individual screening. For example, the general regulations establishing effluent limitations must be translated into specific permit conditions for individual plants; this process involves a measure of discretion that permits some individuation. On the other hand, the Environmental Protection Agency (EPA) is attempting to develop uniform criteria and procedures to evaluate the carcinogenicity and toxicity of pesticides in connection with registration and cancellation decisions.

The characteristics of the products and processes regulated do not by themselves determine the choice between standards and screening. Rather, that choice is a function of social and economic values. A standards approach for chemicals could adopt a single measure of aggregate toxicity based on standardized tests; and new car models could be screened case-by-case, balancing fuel economy, emissions control, safety, and other performance costs. Factors such as administrative ease and equity considerations count heavily in the choice of regulation form.

uniform across the nation and for an entire category of products and processes. For several reasons, administrators prefer uniformity to a more individualized or "fine-tuning" approach to regulation, even though this practice ignores differences in geography and in the characteristics of particular products or processes that can substantially affect the burdens or benefits of control and the feasibility of achieving control.[22] First, by ignoring differences among firms and regions, administrators can economize on decisionmaking costs, including the costs of acquiring and processing information.[23] Second, fine-tuning would require Washington officials to delegate authority to regional federal administrators and to state and local officials, who, they fear, have neither the inclination nor the ability to impose effective controls on regulated firms.

Equity considerations, often aimed at avoiding competitive or regional disruption, also favor uniformity.[24] For example, the uniform technology-based standards in the Clean Air Act Amendments[25] and the Federal Water Pollution Control Act,[26] by imposing the same control requirements on all new or existing plants within a given industry, discourage firms from relocating in areas with high environmental quality.

2. *Culling vs. Technological Transformation*

Environmental, health, and safety regulation has primarily relied on two strategies for achieving improved social performance. One technique is "culling," in which the regulators simply prohibit the use or sale of products and processes that do not satisfy minimum social performance requirements. The other is technological transformation, under which regulators require that the technical characteristics of regulated products and processes be altered to improve social performance.[27] The choice between these strategies, which is a function of

22. Examples of such uniformity include new source performance standards and automobile emissions requirements under the Clean Air Act, 42 U.S.C. §§ 7411, 7521 (Supp. III 1979); the effluent limitations under the Federal Water Pollution Control Act, 33 U.S.C. § 1312 (1976); and the automotive safety standards under the National Traffic and Motor Vehicle Safety Act, 15 U.S.C. § 1392 (1976).

23. "Fine-tuning" would not only involve additional decision costs. It also would allow regulated firms more opportunities to obstruct and delay by insisting on hearings or more formal procedures to consider the particular circumstances of each product or process.

24. *See* R. STEWART & J. KRIER, *supra* note 6, at 368-70. The reliance on geographically uniform ambient air quality standards in the Clean Air Act reflects equity objections to geographical variations in standards whose rationale is protection of public health. Furthermore, congressional representatives have been unwilling to allow federal authorities to encourage economic development in certain regions by allowing greater levels of pollution.

25. *See* note 22 *supra*.

26. *Id.*

27. For chemicals, an alternative or supplemental strategy limits the use of a product or

economic and social norms as well as product and process characteristics,[28] has importance for innovation.

Culling is used for chemicals because their performance characteristics are determined by an integral physical structure. Engineering incremental changes in a chemical's structure to improve social performance, such as reduced toxicity, is often impossible or infeasible without altering performance characteristics valued in the market.[29] Culling is also sometimes used in decisions on the location of major facilities and development projects. Culling is typically accomplished through a screening process.

Culling involves case-by-case judgments on whether an individual substance or project poses risks that are acceptable in light of its benefits. It encourages firms to direct their innovation efforts towards developing chemical products or selecting plant locations likely to survive the culling process. A large portfolio of available chemicals or potential sites tends to ensure that the loss of any one candidate will not involve enormous costs to society.[30]

Congress and administrators have selected the technological transformation strategy where industrial processes and products such as motor vehicles can be altered to improve social performance by fuel switching, "add on" control devices, or process changes. Prohibiting the use or sale of an entire category of products, such as automobiles, or processes, such as copper smelting, would entail enormous social costs. The strategy of choice in such cases is to keep the product or process but gradually to transform its technological characteristics to improve social performance. This strategy is "technology forcing," since it is designed to further development and adoption of technologies that are beyond the present state of the art or that involve a radical transformation of the product or process in question.[31] If the social performance of a technologically flexible product or process can be measured by a common indicator, and if common methods of technological transformation can be identified, technology-forcing regulatory standards for that product or process will likely be developed.[32]

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process. Intermittent control systems can reduce pollution emissions during adverse meteorological or stream flow conditions by curtailing production. Automobile use in polluted areas can be restricted. However, these alternatives can pose serious enforcement problems.

28. *See* note 21 *supra*.

29. Even if the engineering were possible, the nonstandardized nature of the enterprise would make regulation based on a technological transformation strategy difficult.

30. Culling can be selective. Substances can be limited to designated uses or safeguards on use can be required. This approach permits more flexibility but greatly increases monitoring and enforcement costs.

31. For general discussion of the concept of technology forcing, see La Pierre, *Technology-Forcing and Federal Environmental Protection Statutes*, 62 IOWA L. REV. 771 (1977).

32. The required level of social performance first must be determined. In some instances,

3. *Performance, Specification, and Engineering Standards*

The conduct required by standards may be expressed in terms of a performance characteristic (*e.g.*, m.p.g. fuel economy, quantity of emissions, toxicity of ingredients). Alternately, a standard may specify a particular input, such as low-sulphur fuel oil, or a particular engineering design or piece of equipment, such as a flue gas desulfurization "scrubber." Performance standards allow regulated firms flexibility to select the least costly or least burdensome means of achieving compliance. For instance, cost considerations might cause a firm to change its internal processes rather than to incorporate an "end-of-pipe" control to meet standards. Specification standards, on the other hand, offer administrative simplicity and ease of enforcement. Technology to monitor emissions, particularly from industrial sources, in many cases has been expensive, cumbersome, and not very accurate. These drawbacks have allowed regulated firms to resist enforcement through legal challenges related to evidentiary and technical issues.[33] Also, agency monitoring and enforcement resources are often quite limited. With specification standards, enforcement personnel need only check fuel supply invoices or determine whether control equipment is operating.

Engineering standards are a hybrid of performance standards and specifications. In form, they are expressed as pure performance standards. In practice, they are based upon the level of performance that

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such as the control of widespread pollutants from stationary sources, a desired ambient level of environmental quality is established. Controls on individual firms then are targeted to attain that level. In other instances, such as effluent limitations, explicit "technology-based" standards are used. The performance required of firms in an industry is primarily a function of the average industry costs and technological feasibility of improved performance. Some statutes, such as the automotive emissions provisions of the Clean Air Act (CAA), *see* note 9 *supra*, and the fuel economy provisions of the Energy Policy and Conservation Act, *see id.*, set an essentially arbitrary timetable, requiring specific increments of improved performance by specific dates. Other statutes, such as the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act, *see id.*, and the heavy duty motor vehicle provisions of the CAA, give administrators broad discretion to balance costs, benefits, and technological factors to determine the required level of performance. R. STEWART & J. KRIER, *supra* note 6, at 340-46, 505-29. In practice, such costs and benefits are also implicitly taken into account to some extent under the other approaches previously described.

Requirements based directly on improved social performance could be extraordinarily difficult to implement and enforce. For example, it would be very difficult to adjust the stringency of emission control requirements for new automobiles to the level of health hazards generated by automobiles in use in different parts of the country. Regulatory requirements based on surrogate performance measures—such as the availability of a prototype vehicle that can achieve a given emissions level over a 50,000 mile test drive—are easier to enforce, but their relationship to actual social performance is remote. Crashworthiness tests, new source performance standards, water effluent limitations, and state implementation plans for air pollution control all reflect the use of simplifying assumptions and strategies to facilitate implementation and enforcement.

33. *See* Texas v. EPA, 499 F.2d 289 (5th Cir. 1974) (challenge to EPA's determination that state air quality implementation plan did not meet federal standards); Natural Resources Defense Council, Inc. v. EPA, 478 F.2d 875 (1st Cir. 1973) (disputes over emissions modeling).

can be achieved by a specific input or technology. Administrators rely on these specific control measures to determine the required level of performance in order to simplify standard setting, to meet legal challenges to standards' feasibility, and to facilitate enforcement.[34] While regulated firms are in theory free to meet the required level of performance any way they choose, they have strong incentives to adopt the particular technology underlying the standard because its use will readily persuade regulators of compliance.

4. Ex-post and Ex-ante Enforcement Mechanisms

Compliance by individual firms or plants with either standards or screening criteria may be secured either through an ex-ante licensing or clearance process or an ex-post policing process that sanctions violations.[35] Licensing implements the prophylactic strategy of ensuring that products and processes with unacceptable social performance are never employed. By contrast, the deterrent effect of ex-post economic incentives, such as fees, is uncertain because the response of firms to such incentives is difficult to predict. Regulatory statutes have reversed the legal system's traditional presumption in favor of products and processes that pass the test of market acceptance. In the past, products and processes could be sold and operated unless and until the government could carry the burden of demonstrating that they would cause serious social harm. Today, firms generally have the burden of demonstrating acceptable social performance before operation or marketing.[36] This shift profoundly affects firms' innovation incentives.

5. Asymmetrical Regulatory Treatment of New Products and Processes and Affordability Criteria

The principal characteristics discussed thus far are inherent in any system of command-and-control regulation, but the choice among different forms of controls has important implications for innovation.

34. *See* Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375 (D.C. Cir. 1973), *cert. denied*, 417 U.S. 921 (1974); Breyer, *supra* note 11, at 570-75.

35. Under a licensing system, however, policing is required to secure continuing compliance with license conditions and requirements.

36. Policing is employed for latent safety defects or risks through systems such as auto recalls and registration cancellation or suspension based on new information that previously registered pesticides are violating regulatory prohibitions on unreasonable risk. In 1978, the Federal Insecticide, Fungicide, and Rodenticide Act, *see* note 9 *supra*, was amended to require reregistration, in the most expeditious manner practicable, of all pesticides. 7 U.S.C. § 136a(g) (Supp. III 1979), *as amended by* Pub. L. No. 95-396, 92 Stat. 819. This provision has not yet been fully implemented by EPA. The Toxic Substances Control Act, *see* note 9 *supra*, employs a premanufacturing notice scheme that combines elements of licensing and policing. Another variant is found in the regulatory requirements for motor vehicles. A manufacturer normally secures licensing approval based on prototypes or representatives of vehicle models, but compliance by all vehicles in the production run of a model is generally left to policing.

The deliberate policy choices made by Congress and federal administrators have had two notable effects: the imposition of more stringent controls on new sources and products, and the imposition of more stringent controls on sources better able to "afford" controls.

The Clean Air Act[37] and, to a lesser extent, the Federal Water Pollution Control Act[38] impose special technology-based "state of the art" control requirements on all major new pollution sources.[39] National automotive emissions, fuel economy, and safety standards apply only to the manufacture or sale of new vehicles.[40] These requirements, like the new source performance standards applicable to stationary sources, are made increasingly stringent over time.[41] The Toxic Substances Control Act's pre-market notification requirements and associated testing requirements also apply only to new chemical products.[42]

On the other hand, the current regulatory system tends to "grandfather" existing products or processes by subjecting them to less rigorous controls or even no controls. This asymmetry reflects several considerations. Controls or improved process or product characteristics can often be more easily or cheaply designed into new products or processes rather than retrofitted onto old ones. Moreover, imposing stringent controls on existing processes and products may disrupt the expectation interests of firms and consumers.[43] These expectation interests are weak or nonexistent for new products or processes. Imposing stringent controls on existing plants may lead to plant closings and job losses, which are far more politically controversial than a failure to build a new plant because of controls. Finally, stringent control requirements for new sources represent a form of control "insurance" to

37. *See* note 9 *supra*.

38. *Id.*

39. In addition, major new stationary sources of air pollution are subject to a screening process in which they must demonstrate on an individual basis use of "best available control technology" (BACT) or achievement of "lowest achievable emission rate" (LAER), depending upon whether they are constructed in a preveution of significant deterioration (PSD) or nonattainment area. LAER requirements apply in nonattainment areas, BACT requirements in PSD areas. 42 U.S.C. §§ 7503(2), 7475(a)(4) (Supp. III 1979). In some instances a region may be nonattainment for one pollutant and subject to PSD requirements for another. A major new source in such a region may accordingly be subject to both LAER and BACT requirements. LAER and BACT review updates new-source performance standards, which are revised on a five-year cycle and accordingly may not represent current state of the art.

40. 42 U.S.C. § 7521(a)(1) (Supp. III 1979) (emission standards); 15 U.S.C. § 2002(a)(1) (1976) (fuel economy standards); 15 U.S.C. § 1397(a)(1), (b)(1) (1976) (safety standards).

41. 42 U.S.C. § 7521(a)(3)(A)(i)-(ii) (Supp. III 1979) (emission standards); 15 U.S.C. § 2002(a)(1), (4) (1976) (fuel economy).

42. 15 U.S.C. § 2604(a)(1), (2) (1976).

43. The most dramatic example is the sharp and largely successful political resistance to EPA's attempt to limit automobile driving to improve urban air quality. *See* Stewart, *Pyramids of Sacrifice?: Problems of Federalism in Mandating State Implementation of National Environmental Policy*, 86 YALE L.J. 1196, 1202-10 (1977).

safeguard environmental quality in the face of continuing industrial development and uncertainty over the extent of pollution's adverse impact.[44]

The fear of plant closings and the desire to maximize control insurance also explain the pervasive and significant tendency to impose more controls on industries that can better "afford" them.[45] These industries or subgroups typically show higher profits or less demand elasticity for their products. A later section will show how the imposition of more stringent controls on new sources and those better able to "afford" controls has important implications for innovation.[46]

6. *The "Moving Target" Phenomenon*

Command-and-control regulation also has spawned uncertainty and lack of coordination. Regulated firms often cannot predict in advance the content of regulatory requirements. Uncertainties surround the conduct to be regulated, the timing of controls, the stringency of controls, and the costs of complying with them. The specific regulations eventually adopted are a function of many variables.[47] The formal adversary procedures of administrative decisionmaking and the ready availability of judicial review can introduce even more delays and uncertainties into regulation.

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44. If new plants are not controlled to the maximum extent possible through a licensing process, ambient standards may be threatened by continued industrial development. It will be politically infeasible to stop new development at that point or to retrofit substantial additional controls on existing sources.

The Federal Insecticide, Fungicide, and Rodenticide Act, *see* note 9 *supra*, represents an exception to the rather consistent use of a "grandfathering" approach. Recent amendments, Pub. L. No. 95-396, 92 Stat. 819 (1978), not yet fully implemented, require reregistration of all pesticides in use, forcing old as well as new pesticides to run the licensing gamut. A chemical in widespread use is more likely to have generated evidence of adverse effects, and therefore may be more vulnerable to adverse regulatory action than a new product.

45. The affordability criterion is most explicit in the Federal Water Pollution Control Act, *see* note 9 *supra*, effluent limitations, which gear the degree of performance to the cost or technological feasibility of control within a given industry or industry subgroup while apparently excluding consideration of benefits. *See* R. STEWART & J. KRIER, *supra* note 6, at 505-20. The affordability criterion is also used in framing new source performance standards. A similar, but less explicit, tendency to adjust the degree of control to the ability of firms or industries to "afford" control also appears in the implementation of the ambient air standards through state implementation plan requirements. *See* Roberts & Farrell, *supra* note 17.

46. *See* note 98 and text accompanying notes 180-86 *infra*. A firm or industry can pass control costs on to its customers without loss of sales, according to the demand elasticity for its products.

47. These include information on environmental risks; monitoring data; the state of the art of control technology; compliance costs; cousiderations relating to ease of administrative implementation and enforcement; incentives to engage in or avoid litigation; competitive dislocations and other "equity" factors; the identity and attitudes of administrators, regulated industry, environmental advocates and congressional overseers; media attention; and the shifting play of more general political forces.

Even after regulatory requirements have been established, they are likely to be reconsidered and changed. Regulatory measures involve an implicit or explicit accommodation among many interrelated shifting variables that determine how much safety and environmental protection society will demand and pay for. Requirements may be tightened if new information of unexpectedly severe adverse effects from a pollutant or product develops, or if compliance costs are unexpectedly low. They may be relaxed if compliance proves unexpectedly burdensome, or if environmental controls are widely condemned for creating an "energy crisis." Also, environmental regulators often try to tighten the stringency of control requirements in order to maintain environmental quality in the face of continued economic growth. For all these reasons, regulatory requirements may look like uncertain, shifting targets that can chill innovation incentives among regulated firms.[48]

7. Overlapping Regulatory Requirements

Furthermore, a given industry is typically subject to multiple, overlapping, uncoordinated regulatory regimes. Each regulatory statute and program tends to reflect a distinct set of political sponsors, constituents, and objectives. Its implementation often is assigned to a single-purpose regulatory agency or division with exclusive responsibility for implementation. Accordingly, regulatory programs tend to be implemented with comparatively little regard for other programs that apply to the same regulated firms. Outright conflict between regulatory requirements can develop; for example, compliance with air pollution standards may require the use of control equipment that generates prohibited amounts of water pollutants. But outright conflicts appear to be comparatively rare and are resolvable. The more serious danger, particularly for innovation, lies in imposing burdens that, while individually tolerable, together create severe costs, constraints, delays, or uncertainty. For example, if several separate regulatory requirements, such as emissions, fuel economy, and safety requirements for automobiles, are each established according to a parochial assessment of what the regulated industry can "afford," the cumulative financial burden could be severe. The cumulative effect of air pollution, water pollution, and land use controls may seriously restrict the availability of new industrial sites. The total impact of independent requirements may constrain the technology of the regulated product or process and

48. Different regulatory tools or strategies will allocate the burden of uncertainty and change in different ways. For example, under a command-and-control system, unexpectedly high control costs will be borne by the industry unless the stringency of regulations is relaxed. Under a fee system, these costs will result in lower levels of control unless fees are increased. In the first case, the risk of unexpectedly high control costs is imposed on firms; in the second, it is imposed on the environment and those exposed to pollution, health, and safety risks.

affect resulting corporate strategy in unexpected ways.[49] The need to obtain multiple permits from many authorities also may add to regulatory delay and uncertainty.

Some statutory provisions, including the fuel economy provisions of the Energy Policy and Conservation Act[50] and the heavy duty motor vehicle provisions of the Clean Air Act,[51] attempt to deal with the problem of multiple regulatory agencies by requiring each responsible agency to consider the impact of its requirements on the others' mission. However, no specified mechanism provides for resolution of conflicts or stalemates by a higher authority.[52]

B. Decisional Processes

The current system of environmental, health, and safety regulations relies heavily on formal, lawyer-dominated procedures for decisions by regulatory administrative agencies and on court litigation to review the decisions of those agencies. The use of these procedures is closely tied to the choice of command-and-control regulation tools to deal with health, safety, and environmental problems. Command-and-control regulation involves government coercion and requires administrators continuously to decide disputed engineering, cost, and scientific issues. This system has invited formal procedures and judicial review to control agency discretion.

1. Rulemaking

Regulatory standards that apply uniformly to a broad category of

49. *See* R. LEONE, W. ABERNATHY, S. BRADLEY & J. HUNKER, REGULATIONS AND TECHNOLOGICAL INNOVATION IN THE AUTOMOBILE INDUSTRY ch. 4, at 6-7 (1980) (OTA Report) [hereinafter cited as R. LEONE]. The adverse impacts of cumulative, but uncoordinated, regulatory regimes are not confined to regulated firms. The regulatory requirements imposed by one regulatory agency, such as EPA emission controls on vehicles, may impede the achievement of some other agency's objective, such as the Department of Transportation's goal of increasing automotive fuel economy.

50. 15 U.S.C. § 2002(e)(3) (1976).

51. 42 U.S.C. § 7521(a)(3)(A), (C) (Supp. III 1979).

52. Coordination or adjustment of different regulatory systems administered by different agencies to deal with particular instances of conflict or undue burden would undermine uniformity, afford regulated firms more opportunities for delay and obstruction, and run athwart the power of single-purpose agencies grounded in support by congressional allies to defend their "turf." For example, EPA in 1975 effectively defeated a negotiated agreement between the administration and the automobile industry on fuel economy by refusing to relax emission requirements as called for by the agreement. R. GOODSON, FEDERAL REGULATION OF THE AUTOMOBILE 24-27 (1979). Nor is combining regulatory responsibilities in a single agency a complete answer. Containing all related regulation functions would produce an unwieldy super-agency, internally divided by the need for bureaucratic specialization. In addition, there are legal uncertainties and practical difficulties in relying upon the President to achieve coordination and consistency by directing administrators to adopt particular decisions. *See* S. BREYER & R. STEWART, ADMINISTRATIVE LAW AND REGULATORY POLICY 149-59 (1979).

activities, processes, or products are normally promulgated in regulations that are the product of agency rulemaking. Industrial air and water pollution control standards and the various standards for automotive emissions, safety, and fuel economy typically have been established through the notice-and-comment rulemaking procedures of the Administrative Procedure Act (APA).[53] The APA procedures require that the responsible agency publish a notice of proposed rulemaking in the *Federal Register*, describing the proposed regulation and its rationale; that interested persons be afforded an opportunity to submit written comments on the proposed regulation (and, in the discretion of the agency, oral argument); and that the agency, upon promulgation of a final regulation, publish a concise explanation of its reasons. The relevant organic statute may require additional procedures, such as legislative-type oral hearings.[54]

The notice-and-comment procedures introduced by the APA in 1946 were intended to broaden "outreach" by extending the informational and judgmental capacity and response of the agencies. Administrative staff, by virtue of specialized experience, develop a fund of knowledge concerning the field to be regulated. But limitations of agency resources, operational experience, and perspective make it desirable to also draw upon the understanding and views of interested persons. APA notice-and-comment procedures were designed to promote outreach by providing interested persons an opportunity to submit views and data while leaving the agency free to make decisions on an informal basis, relying on whatever other information or input it deemed useful. The procedures were not originally conceived as adversary mechanisms whereby outside parties could check agency power and lay the groundwork for judicial review.[55]

In the late 1960's widespread distrust of regulatory agencies and a desire to assure careful and accurate agency resolution of technical issues led reviewing courts to transform the character and purpose of notice-and-comment rulemaking by elaborating the basic APA procedures.[56] Courts also developed a more stringent standard of judicial

53. 5 U.S.C. §§ 551-559 (1976).

54. *See* 1 K. DAVIS, ADMINISTRATIVE LAW TREATISE § 6:9 (2d ed. 1978).

55. *See* Auerbach, *Informal Rule Making: Proposed Relationship Between Administrative Procedures and Judicial Review*, 72 NW. UNIV. L. REV. 15, 23-24 (1977); Nathanson, *Probing the Mind of the Administrator: Hearing Variations and Standards of Judicial Review Under the Administrative Procedure Act and Other Federal Statutes*, 75 COLUM. L. REV. 721, 755-59 (1975).

56. Judges required agencies to disclose the documentary data and analyses underlying rulemaking proposals; to engage in a fresh round of notice-and-comment if their initial proposals were significantly modified or if public comments raised new issues; to justify their final decisions, responding specifically to objections and adverse data presented in public comments; and to include all relevant documentary analysis and data (including that generated within the agency or otherwise relied upon by it in making decisions) in the materials available to the court on judicial

review, seeking to ensure that agencies took a "hard look" at relevant data and analyses and at competing policy choices.[57] This approach to review required an extensive record containing all data and analyses bearing on the agency's decision. These requirements led to the creation of "paper hearing" procedures that generated a record to serve as the exclusive basis of agency decision and judicial review.[58] In the 1977 Clean Air Act Amendments,[59] Congress endorsed these judicial developments by requiring "paper hearings" for Environmental Protection Agency (EPA) rulemaking under the Act.[60]

Paper hearing requirements have formalized rulemaking, increased the time and resources required for decision, and given outside parties procedural weapons that can be used to obstruct or delay agency actions. While paper hearings and hard look review have served an important quality control function, the free flow of information and views may be blocked or distorted by tactical considerations; outside parties and agency staff have incentives to present extreme, one-sided positions as a foundation for judicial review.[61] The agency often proposes measures of greater rigor than it eventually adopts, while the regulated industry in many cases mounts a wholesale attack on the proposal without offering constructive alternatives. Off-the-record communications are limited once rulemaking begins.[62] These conditions hinder informal bargaining and undermine the outreach function of the original notice-and-comment procedures. The resulting information blocks are particularly significant today because agencies engaged in far-reaching command-and-control regulation increasingly depend on outside data in resolving engineering, economic, and scientific issues. If standards are adopted or culling decisions made on the basis of partial information or inadequate understanding of industry compliance problems, innovation is likely to suffer.

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review. *See, e.g.*, Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375 (D.C. Cir. 1973), *cert. denied*, 417 U.S. 921 (1974); International Harvester Co. v. Ruckelshaus, 478 F.2d 615 (D.C. Cir. 1973); Kennecott Copper Corp. v. EPA, 462 F.2d 846 (D.C. Cir. 1972).

57. *See* Greater Boston Television Corp. v. FCC, 444 F.2d 841, 851 (D.C. Cir. 1970), *cert. denied*, 403 U.S. 923 (1971).

58. *See* Stewart, *The Development of Administrative and Quasi-Constitutional Law in Judicial Review of Environmental Decisionmaking: Lessons from the Clean Air Act*, 62 IOWA L. REV. 713, 729-33 (1977).

59. *See* note 9 *supra*.

60. 42 U.S.C. § 7607(a) (Supp. III 1979).

61. *See* Darman & Lynn, *The Business-Government Problem: Inherent Difficulties and Emerging Solutions*, in BUSINESS AND PUBLIC POLICY 59 (J. Dunlop ed. 1980).

62. *See* Home Box Office, Inc. v. FCC, 567 F.2d 9, 57 (D.C. Cir.), *cert. denied*, 434 U.S. 829 (1977). *See also* Action for Children's Television v. FCC, 564 F.2d 458 (D.C. Cir. 1977) (discussing but not applying the limitation).

2. Adjudication

While regulatory standards typically are adopted through rulemaking, controverted screening decisions typically are subject to adjudicatory procedures involving trial-type hearings. In a pesticide cancellation proceeding, for example, the manufacturer generally is entitled to a full dress trial, including live testimony by witnesses and cross-examination. Screening decisions under the Toxic Substances Control Act and the determination of individual air and water pollution permits for particular plants are also instances of adjudication, although the extent to which formal trial procedures apply remains uncertain.[63] These procedures can introduce more cost, delay, and uncertainty into the system. To avoid the resource burdens and delays associated with trial-type hearings, regulatory agencies have sought to resolve certain recurrent generic issues through less formal rulemaking procedures. They also have tried to put a heavy burden on regulated firms or on environmental advocacy groups to show a genuine evidentiary conflict on central factual issues that justifies a trial-type hearing. These efforts have been buoyed by the growing conviction that full-fledged trial-type procedures often are not well suited to resolving regulatory problems that combine economic, engineering, and scientific issues with wide-ranging policy considerations.[64]

3. Availability of Judicial Review

Judicial review of administrative action traditionally was available only to persons challenging agency enforcement of regulatory sanctions against them. But over the past fifteen years the availability of judicial review has been greatly liberalized by judicial decisions and statutory enactments.

Relaxation of standing requirements has led to multilateral judicial review proceedings, involving regulated firms, the agency, and environmental and consumer advocates. Since agency proceedings form the basis for judicial review, they too have become multilateral, thereby increasing their complexity and length.[65] Finality and ripeness requirements also have been relaxed so that litigants need no longer wait until the enforcement stage to secure review.[66] This practice may permit

63. *See* Costle v. Pacific Legal Foundation, 445 U.S. 198, 213-16 (1980).

64. *See* Boyer, *Alternatives to Administrative Trial-Type Hearings for Resolving Complex Scientific, Economic and Social Issues*, 71 MICH. L. REV. 111, 114-37 (1972). The developments described in the text, together with the rise of paper-hearing procedures in rulemaking, have tended to blur traditional procedural distinctions between rulemaking and adjudication. *See* DeLong, *Informal Rulemaking and the Integration of Law and Policy*, 65 VA. L. REV. 257, 259-60 (1979).

65. *See* Stewart, *The Reformation of American Administrative Law*, 88 HARV. L. REV. 1667, 1723-48 (1975).

66. If an environmental/consumer advocate can make a prima facie case that the agency has

threshold legal issues to be resolved more quickly, but it also may encourage litigation by reducing its costs and risks.[67]

Moreover, the rigor of judicial review has changed, partly because of legislative developments and partly because of new judicial practice. Congress has sought to limit agency discretion by adopting more detailed statutory provisions,[68] and by imposing specific deadlines for implementing regulatory programs, thereby multiplying the grounds and occasions for judicial review.[69] Courts, as previously noted, have shown their distrust of agency discretion by tightening traditional standards of review through a "hard look" approach.

These steps to restrict and control administrative discretion repudiate the New Deal conception of the regulatory agency as a technically expert manager, in the public interest, of given aspects of the economy. Specialized experience on the part of the agency staff and informal exchange with interested private persons were supposed to provide the knowledge base for regulatory initiative and supervision. Under this view, formal decisionmaking procedures and searching judicial review were undesirable because they might impede management autonomy and flexibility in the agencies, which should be left wide discretion and initiative to plan, implement, and revise measures to realize basic social goals under changing circumstances.[70] The developments of the past fifteen years have undermined this conception.

II

REGULATION AND INNOVATION: A CONCEPTUAL FRAMEWORK

Part II develops a conceptual framework that defines the relationship between regulation and innovation and then applies that framework to existing regulatory programs to assess their effect on

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been derilect in carrying out its statutory responsibilities, it may secure review of a failure to initiate enforcement. *See* Environmental Defense Fund, Inc. v. Ruckelshaus, 439 F.2d 584 (D.C. Cir. 1971). Moreover, when an agency promulgates a regulation, both regulated firms and advocacy groups generally can secure immediate review. *See* Abbott Laboratories v. Gardner, 387 U.S. 136 (1967).

67. In addition, the promulgation of regulatory standards is likely to affect many more firms and groups than an individual enforcement action, thereby promoting multiparty proceedings.

68. For example, Congress was unwilling to leave the trade-offs between automotive fuel economy, on the one hand, and auto safety and emission control on the other to negotiation between the administration and the automobile manufacturers; it insisted upon legislating specific regulatory requirements. R. GOODSON, *supra* note 52, at 14-29.

69. *See, e.g.*, Alabama Power Co. v. Costle, 606 F.2d 1068 (D.C. Cir. 1979) (industry and environmentalist challenges to air quality regulations on a wide variety of grounds).

70. *See* B. ACKERMAN & W. HASSLER, CLEAN COAL DIRTY AIR 1-12, 60-65, 116-22, 267 (1981) (discussion of "New Deal" model of administrative agency); J. LANDIS, THE ADMINISTRATIVE PROCESS 47-89 (1938).

innovation.[71] Later sections use this framework to examine alterna-

71. Any effort to evaluate the impacts of regulation on innovation or to modify regulation to improve its performance with respect to innovation must rest on one or more models, implicit or explicit, of the interactions between firms' innovation investment decisions and government measures. Economic literature offers several such models. One examines the impact of regulation on innovation at the level of the individual firm, assuming that the firm makes marginal adjustments in profit-maximizing investment decisions in response to government regulations that affect the funds available for investment or the profitability of such investment. Under this approach, the level and direction of market innovation will be a function of a firm's resources, technical and market opportunities, and four aspects of regulation: technical constraints, compliance and decisional costs, uncertainty, and delay. This section takes this basic approach and discusses the relationship between these four factors and innovation.

An alternative industrial organization model takes the industry, rather than the individual firm, as the point of reference. It seeks to determine the impact of regulation on the structure of the industry, and then relates industry structure to innovation. For example, many forms of regulation, such as uniform testing requirements for new pesticides, impose relatively higher costs on smaller firms within an industry, raise barriers to entry, and increase concentration. The implications of these effects for innovation are, however, uncertain. Some theories claim that small firms have the flexibility and entrepreneurial spark to play a major role in innovation; other theories argue that large firms with substantial research and development budgets contribute more to innovation. *See generally* TECHNOLOGICAL INNOVATION: A CRITICAL REVIEW OF CURRENT KNOWLEDGE (P. Kelly & M. Kranzburg eds. 1978) [hereinafter cited as TECHNOLOGICAL INNOVATION]; Ginsburg, *Antitrust Uncertainty and Technological Innovation*, 24 ANTITRUST BULL. 635, 649-50 (1979).

Studies of the relations between industry structure and innovation have focused on market innovation and have paid little attention to social innovation. More stringent regulatory requirements are imposed on firms and industries better able to "afford" them. *See* text accompanying notes 39-47 *supra*. These are likely to be large firms with market power and industries predominantly composed of such firms. If these firms have greater innovation capabilities, then this allocation of regulatory "demand" may increase the extent of social innovation supplied.

A third model posits that industries follow an innovation "life-cycle." *See* W. Abernathy & J. Utterback, *Patterns of Industrial Innovation*, 80 TECH. REV. 41 (1978). Early in the life cycle, innovation takes the form of basic product or process innovations; whereas in "mature" stages, it consists of incremental cost-saving adjustments to relatively stable, high volume, capital-intensive production processes. Where this model applies, adjustments in regulatory incentives in the "mature" phase elicit only a limited response. If more basic changes in product or process are sought, such as an entirely new type of automobile engine, intrusive government controls over firm investment decisions may be necessary. Innovation may be easier to secure in the case of capital goods, such as new plants, that are to a considerable degree "hand-tailored," or in the case of a multiproduct industry, such as chemical manufacture, where entirely new products are regularly introduced.

A fourth model emphasizes the role of corporate strategies in innovation decisions. Empirical studies of firm behavior indicate that firms rarely optimize investment and marketing decisions in the fashion suggested by classical profit-maximizing models. Information and decisionmaking costs lead them to adopt rule-of-thumb corporate strategies based on an assessment of the firm's environment and its comparative advantages. The impact of regulation on innovation may be heavily shaped by the corporate strategy of the firms regulated. For example, the impact of the testing requirements of the Toxic Substances Control Act, *see* note 9 *supra*, may vary tremendously depending on whether a firm attempts to identify individual large-volume chemicals before production and marketing, or whether it does small-volnme test marketing of many chemicals initially. The impact of automotive fuel economy and emissions requirements has been profoundly influenced by the competitive position and corporate strategies of various domestic and foreign automobile manufacturers. *See* R. LEONE, *supra* note 49.

Because of the relatively primitive state of our understanding of innovation, any effort to determine the relationship between regulation and innovation must remain tentative. For a useful

tives to existing programs that would increase both market and social innovation.

Market innovation refers to product or process innovations that create benefits that firms can capture through the sale of goods and services in the market. These innovations include new or improved products with greater appeal to consumers and process changes that reduce manufacturing costs or facilitate the manufacture of new or improved products. Social innovation refers to product or process innovations that create social benefits, such as cleaner air, that firms cannot directly capture through market sales. Such innovations may, however, confer private economic benefits on the firms if they reduce the costs of responding to government regulatory requirements or incentive systems.

A given innovation may confer both market and social benefits. For example, a system to recycle waste water in manufacturing processes may not only facilitate compliance with water pollution control requirements but also reduce manufacturing costs. Moreover, an innovation that enables one firm to meet industry-wide regulatory requirements or incentives more cheaply than its competitors will allow the innovating firm to produce its products more cheaply and thereby capture market benefits. Also, firms that produce and sell abatement equipment and other commodities designed to achieve improved social performance will enjoy market benefits from such sales.

A. The Relationship Between Regulation and Market Innovation

Regulation may adversely affect market innovation in four ways:

(1) by imposing technical constraints on firms;
(2) by forcing firms to make additional expenditures or outlays;
(3) by causing uncertainty; and
(4) by causing delay.

The extent of these effects is a function of the stringency of the regulation and the particular regulatory tools employed.[72]

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review of the innovation literature, see Ginsburg, *supra*. The discussion that follows generally relies on the first model, but the other three models are invoked where they seem most relevant. *See also* W. Magat, *The Effect of Environmental Regulation on Innovation*, 43 L. & CONTEMP. PROB. 4, 7-11 (1979), which develops a model of the relations between various forms of regulation and innovation.

72. The stringency of regulatory requirements consists of the effective level of social performance demanded. Stringency is a function of the minimal level of social performance required and the efficacy and credibility of the incentives or sanctions employed. The level of stringency affects market innovation because more stringent requirements are likely to involve more severe constraints and higher costs. But the impact of regulatory measures on innovation is not solely a function of stringency. At any given level of stringency, the impact of the four elements listed in the text will vary substantially, depending upon the precise regulatory tools and decisional procedures employed.

Command-and-control requirements contained in screening criteria or in standards impose direct constraints on firms' conduct, foreclosing certain forms of market innovation. For example, regulatory constraints may forbid the location of new industrial sources of pollution in certain areas or the manufacture of certain products or require that product design incorporate specific features. Whether constraints are expressed as proscriptions banning specified conduct or performance characteristics or as prescriptions requiring certain conduct or characteristics,[73] the key variable is how much the requirements restrict manufacturers' freedom to adopt new products or processes that would enjoy market success.[74]

Command-and-control regulation also forces firms to make direct resource expenditures that include compliance outlays to meet regulatory requirements. Under a culling approach, for example, these outlays consist of testing costs and other expenditures for developing and manufacturing products likely to pass the testing requirements. These outlays may divert limited capital resources from investment in market innovation. Moreover, if compliance outlays are higher for new products or processes, investment in innovation will be further inhibited.[75] Another form of resource expenditure consists of decisional outlays to cover costs incurred in ascertaining regulatory requirements and persuading regulators that a new plant or product will comply with such requirements. Decisional and compliance outlays also include diversion of management and research resources to regulatory matters, a diversion that may involve substantial opportunity costs.

Delay in ascertaining and meeting regulatory requirements for new products and processes postpones, and therefore reduces, the return on innovation investment, thereby contributing to the comparative advantage of existing products and processes.

Uncertainty concerning regulatory requirements involves the risk to firms that preliminary investment in a new plant or product will be lost entirely if the project subsequently fails to meet regulatory require-

73. These formal differences have little significance for our purposes; a prescription can readily be expressed as a proscription, and vice-versa. For example, the Clean Air Act, *see* note 9 *supra*, forbids the sale of automobiles unless they satisfy certain emission requirements—a proscription. But the relevant provisions could as well be expressed as a prescriptive requirement that manufacturers of automobiles achieve a specified level of emissions performance. In either case the manufacturer can comply or cease sales.

74. Design standards and engineering standards based on particular technologies are likely to be more constraining and impose higher opportunity costs than performance standards because they rule out more potential innovations.

75. Robert Leone suggests that high compliance costs imposed on new sources have caused investment in highly efficient, large-scale new capacity to become uneconomic or unduly risky. He contends that forcing firms to make a series of less efficient incremental modifications or additions to existing capacity results in a serious loss of productivity. Leone, *The Real Costs of Regulation*, 55 HARV. BUS. REV. 57 (1977).

ments. Even if clearance is obtained, firms run a risk that new regulatory requirements or the delays involved in clarifying such requirements will shrink the return on their investments. Such risks discourage innovation.

Command-and-control regulatory requirements can be modified to avoid or reduce any one of these four adverse effects on market innovation, but only by increasing one or more of the other adverse effects. For example, a firm might seek to reduce the constraints and compliance outlays imposed under a uniform standards approach by attempting to have the standards overturned, modified, or replaced by a screening system. But this alternative creates more delay and uncertainty and higher decisional costs. Many delays and uncertainties in a screening approach could be eliminated by the adoption of rigid, uniform standards, but this alternative probably would increase constraints and compliance costs. Uncertainty can be reduced by regulatory or legal proceedings, but only at the price of delay and more decisional outlays. It is also important to note that all four elements—constraints, outlays, delay, and uncertainty—generally burden new products and processes far more than existing ones.[76]

B. The Relationship Between Regulation and Social Innovation

Government, rather than the market, ordinarily must provide incentives for regulated firms to undertake investment necessary to generate social innovation. The purpose of such incentives is to create an effective demand for improved social performance,[77] leading firms to develop and adopt socially superior products and processes. The nature of regulatory demand for social innovation depends upon the efficacy and credibility of regulatory enforcement, the precise nature of regulatory tools employed, and the decisional processes through which they are applied. Unfortunately, little attention has been paid to incentives for social innovation provided by regulatory programs. However,

76. Sometimes regulatory requirements may increase market innovation by directing firms' attention to neglected innovation opportunities or by providing a stable environment that supports profitable innovations. For example, water pollution control requirements have led some firms to examine and adopt recycling and other process changes that create a net economic saving. Fuel economy regulations may have reduced uncertainty in automobile manufacturers' response to market demands for fuel-efficient vehicles. *See* R. LEONE, *supra* note 49, at 3-32. Because large firms "satisfice" and do not engage in ruthless and continuing cost minimization, regulatory controls may trigger "search" efforts that tap neglected opportunities. But such effects are presumably random, and their magnitude quite uncertain.

77. Empirical studies indicate that most market innovations are initially stimulated by the potential market demand for a successful innovation, rather than the supply of promising technical opportunities. *See* Note, *Forcing Technology: The Clean Air Act Experience*, 88 YALE L.J. 1713, 1728 n.74 (1979). Arguably, a similar relationship exists between social innovation and social demand, suggesting that various forms of regulation should be assessed according to the nature and level of the demand for social innovation that they create.

there is reason to fear that the incentives provided by existing command-and-control approaches are seriously deficient.

1. Diffusion vs. Invention

Invention (the development of a new product or process that advances the relevant state of the art) can be distinguished from diffusion (widespread adoption of the current state of the art), although innovation encompasses both terms. The choice of regulatory tools may affect the relative incentives of firms to invest in invention or diffusion.

The culling approach applied to chemicals seeks to stimulate invention of socially superior products. The underlying assumption is that elimination or restriction of inferior products, together with continued market demand for products of the regulated class, will stimulate the research and investment required to produce chemicals offering superior social performance. "Technology forcing" under a culling approach would involve stringent criteria excluding most or all existing products in order to force firms to develop substitute products with superior social performance.

The elements of the technological transformation strategy are different. If technologies to achieve improved social performance are well established, government can ensure their diffusion either directly through design standards or indirectly through engineering standards. This approach works well for "end of pipe" control technologies, such as catalytic converters for automobiles or flue gas desulphurization scrubbers that can be added to a variety of existing product or process technologies. If control technologies are not well established, devising effective incentives for social invention under command-and-control standards is much more difficult. Regulatory agencies can try to anticipate and thus "force" the state of the art by adopting standards based on a regulatory agency's estimate of the most promising technical opportunities. But if the firms subject to regulation must develop the technology that will achieve those standards, the regulatory agency may suffer serious handicaps in acquiring the information necessary to justify its estimate of the most promising technical opportunities. The regulated industry is likely to have a far greater working knowledge of the products or processes sought to be transformed than the regulating agency,[78] and accordingly is likely to be in a strong position to challenge, through litigation, the operational feasibility of standards

78. Regulatory agencies' internal knowledge, staff, and financial resources are generally not adequate to permit them, in more than a few cases, to develop the invention or do sufficient technical ground work to demonstrate its probable feasibility. These difficulties can only be partially alleviated by retaining outside contractors. *See* Breyer, *supra* note 11.

designed to "force" technology.[79] On the other hand, the regulated industry has no incentive—in fact, a powerful disincentive—to develop or disclose promising inventions that would facilitate higher levels of social performance. Regulated firms will be motivated to support research and development on inventions enabling them to comply with existing standards more cheaply, but the results may not yield a higher level of control.[80]

2. External Supply of Innovation

The prospect of new markets might stimulate suppliers, such as pollution control equipment manufacturers, to invent new control technologies designed to achieve a higher level of social performance. The market incentive could motivate suppliers to invest in social innovation and communicate successful results to regulators who could then require firms to adopt such innovation. Unfortunately, these incentives are undercut by the "moving target" character of regulatory policy, which diminishes the possibility of a stable market.[81] Moreover, suppliers often lack either the working know-how or the capital to demonstrate commercial-scale feasibility of a new technology without the active cooperation of regulated firms. The agency itself may seek to develop the necessary innovations, but this approach has obvious limitations. These considerations help to explain why regulatory agencies tend to base standards on the demonstrated technological state of the art, creating a diffusion strategy for technological transformation.

3. Constraints, Outlays, Delay, and Uncertainty

The extent of social innovation generated by regulatory "demand" is also a function of the same four variables discussed in connection with market innovation. However, the relationships between innovation and regulatory constraints, outlays, delays, and uncertainties are somewhat different for social innovation. Both culling and technological transformation involve direct restraints on firms. Because unduly severe restraints could have serious social and economic impacts, agencies cannot ignore compliance costs and must insure that regulatory requirements are broadly "affordable." Standards also demand only that firms meet a given level of conduct; they are penalized for falling short, but not rewarded for going beyond. The interplay between these factors encourages agencies to tighten standards incrementally to

79. *See, e.g.*, International Harvester Co. v. Ruckelshaus, 478 F.2d 615 (D.C. Cir. 1973).

80. Cost-saving control innovations may lead regulators to tighten controls on the grounds that greater stringency is now "affordable." This risk undercuts the incentive of regulated firms to invest in such innovations.

81. *See* Ginsberg, *Making Automobile Regulation Work: Policy Options and a Proposal*, 2 HARV J.L. & PUB. POL'Y 73, 97-101 (1979).

match or modestly force the advance in affordable state-of-the-art control technology.[82] This approach does not create demand for radically new, albeit potentially superior technologies, because the uncertainties and time delays in their development would create substantial risks of noncompliance,[83] and because social performance that exceeds the required minimum is not rewarded.

Uncertainty and delay concerning the level of social performance that may be demanded also undercuts the incentive to invest in innovations promising superior social performance. At the same time societal aversion to plant shutdowns minimizes the risk of drastic sanctions being imposed when firms fail to achieve high levels of social performance. Because draconian sanctions, particularly for existing products and processes, are often not credible, forcing far-reaching technological transformation through command-and-control regulation is difficult.

C. The Complementary Character of Market and Social Innovation

At first glance, the goals of market innovation and those of social innovation seem to be irreconcilable. Promoting social innovation through regulation creates constraints and outlays that hinder investment in otherwise profitable market innovations. Government measures aimed at generating demand for social innovation involve delays and uncertainties that further discourage market innovation. As stringency increases, more social innovation and less market innovation apparently will occur. Alternatively, if stringency is relaxed, market innovation will advance, but social innovation will suffer. Regulation appears as a zero-sum game involving a direct trade-off between market and social innovation that can, in the end, be resolved only by a political power struggle. But this appearance is misleading. The dynamic interplay between market and social innovation shows that they can be complementary in many contexts.

There are, to be sure, cases of total conflict. At one extreme, regulatory requirements might be so lax as to have no effect on firms' investment decisions, which then would be totally determined by market forces. At the other extreme, a product or process might be banned because of its social consequences, leaving market incentives totally subordinated to social goals (although it would be strained to speak of such a case as involving social innovation).

But most cases fall between these extremes. Regulated products,

82. *See* La Pierre, *supra* note 31, at 774-76.

83. Lead time is also important. Emission-reduction strategies for new sources are often far more capital intensive than the strategies adopted for existing sources, where regulatory deadlines may preclude capital intensive strategies that require longer lead times to install than alternatives such as fuel switching. Note, *supra* note 77, at 1729.

such as chemicals or automobiles, continue to be sold and industrial processes continue to operate in response to market demands, because the social costs of an outright ban would be too great. Government instead seeks to modify such products and processes to promote social objectives, which often are achieved most easily through investing in new products and processes, rather than altering existing ones. It is generally far cheaper and less disruptive to design improved social performance into a new plant or automobile than to retrofit an existing one. For chemicals, retrofit is generally impossible. The difficulty of transforming existing products might suggest that social performance could best be improved by imposing stringent requirements on new products and processes. But this strategy ultimately would discourage innovation by making new products and processes too costly for the market to support.

Accordingly, the key to long-run improvement in social performance is turnover of plants and products. Unduly stringent regulatory requirements, particularly those directed at new products and processes, can impede the investment and turnover that creates improvements. Accordingly, a successful regulatory strategy must provide adequate incentives for both market and social innovation. Furthermore, it must be sensitive to the threat of economic and social disruption. For example, under a culling strategy, stringent screening criteria could eliminate most existing products and thus create market demand for substitutes with superior social performance. The danger, however, is that substitute products will not be forthcoming at comparable costs. Unmet demand could create widespread disruption.

Under a technological transformation strategy, regulators also must balance market investment and social innovation incentives. Imposing more stringent regulatory requirements on new products and processes imposes high costs and severe constraints that stunt the market demand needed to underwrite future investment in such products or processes. Milder regulatory requirements encourage faster turnover of the capital stock, but the mildness of such requirements may not spur social innovation. If stringent requirements are imposed upon existing, as well as new, products and processes, the incentive to invest in new products and processes may be restored or even increased and social innovation correspondingly advanced. But retrofitting and modifying existing products and processes is a more costly way to improve social performance. Moreover, society is averse to the disruption caused by widespread plant closings and product bans. Government policies explicitly aimed at achieving a regulatory version of Schumpeterian "creative destruction"[84] will generate politically power-

84. For Schumpeter's account of the "creative destruction" wrought by technological inno-

ful opposition from affected firms, consumers, and employees.

If political aversion to disruption were not a factor, a culling strategy incorporating demanding criteria or a technological transformation strategy imposing stringent requirements on both existing and new products and processes might be justified, even if domestic firms failed to provide the social innovation needed to produce products and processes with acceptable social performance. If foreign manufacturers can meet requirements for high fuel economy, low-emission vehicles but domestic manufacturers cannot, domestic manufacturing capabilities perhaps should be diverted to other products or processes.[85] If neither domestic nor foreign manufacturers can achieve the required level of social performance, perhaps consumer demand might profitably be shifted to other products and processes.

But political opposition to the dislocations involved normally precludes ambitious pursuit of these strategies. Accordingly, improved social performance often depends on maintaining adequate market incentives for investments in new products and processes that are of the same general type as those being sold or employed by domestic firms but that can more readily incorporate social innovations. Social innovation often must piggyback on market innovation. This imperative mandates careful consideration of the relative stringency of culling criteria and technology-transforming standards imposed on new versus existing products and processes. It also suggests, as developed later in this Article, the desirability of exploring alternatives to traditional command-and-control regulation that might better exploit the complementary relationship between market and social innovation.

The following paragraphs show how this analytical framework applies to environmental, health, and safety regulatory programs. Automobile regulatory controls for all practical purposes apply only to new produets.[86] Annual model changes and annual adjustment of regulatory measures have subjected the production of automobiles to ever-tightening regulatory requirements. If these requirements become too costly and constraining, new car sales will decline and both market and social objectives will suffer. Given this risk and the weakness of regulatory incentives for invention, it is not surprising that regulatory requirements and technological advance have progressed incrementally,

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vation in a capitalist system, see J. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 81-120 (3d ed. 1950).

85. *See* Graham, *Technological Innovation, the Technology Gap and U.S. Welfare*, 27 PUB. POL'Y 185, 198-201 (1979).

86. Retrofit measures to reduce emissions from old automobiles have been dropped or greatly relaxed in the face of political opposition. *See* R. STEWART & J. KRIER, *supra* note 6, at 441-75.

disappointing proponents of far-reaching technology forcing.[87]

Stationary-source air and water pollution controls on new sources are often far more stringent than those for old sources. In addition, delays and uncertainties are far more significant for new sources. These disparities in regulatory treatment reduce the turnover of the capital stock vital to improved social performance and frustrate technology forcing.[88]

Regulations automatically subject new pesticide products to screening, but established pesticides are subject only to periodic review and policy. Because the Federal Insecticide, Fungicide, and Rodenticide Act[89] and the Toxic Substances Control Act[90] rely on product-by-product screening rather than standards, regulation of chemicals involves delays and uncertainties that fall especially hard on new products. On the other hand, more evidence of adverse effects may be available for products already on the market, thus making them more vulnerable to government proscription. To date, relatively little effort has been directed at technology forcing through stringent screening criteria that would exclude most products now marketed and create large market opportunities for products with superior social performance. These examples illustrate the need for far more systematic consideration of the interplay between social and market innovation in the design and implementation of regulatory programs.

D. Institutional Innovation: Redefining the Problem

Redefining the problem calling for government intervention and a corresponding restructuring of regulatory programs and incentives often may be the key to market and social innovation. The traditional regulatory system's focus on incremental modification of the status quo frequently ignores such opportunities.

The preceding discussion has explored the assumption that the path to improved social performance lies either in a culling approach designed to encourage regulated industries to replace existing products with others of the same type offering superior social performance, or in a technological transformation approach designed to force regulated

87. Social innovation has been exceptionally rapid and far-reaching for automobile fuel economy. This success can be explained, consistent with the framework developed above, by higher gasoline prices and fears of shortages that imposed the equivalent of a regulatory burden on existing cars, thereby facilitating the imposition of fuel economy requirements on new cars. Because regulatory measures to increase new car fuel economy reduce vehicle size and performance, they would, in the absence of shortages and gasoline price increases, reduce demand for new cars.

88. On the other hand, facilitation of new investment may increase total production, which would tend to increase pollution.

89. *See* note 9 *supra*.

90. *Id.*

industries to modify existing products and processes to enhance social performance. These approaches ignore the innovation potential of entirely new products or services from entirely new industries. For example, the solution to the pesticide problem may lie not in prohibiting manufacture of relatively unsafe chemicals, but in creating, through a combination of informational, regulatory, and fiscal techniques, entirely new agricultural practices that involve less reliance on chemical pesticides. Similarly, the best solution to the problem of air pollution from coal-fired power plants may lie not in devising more effective incentives for the development of improved combustion or control processes, but in basic changes in public utility regulatory incentives that would lead utilities to invest in cogeneration, conservation, and solar generation rather than investing in new large-scale generating plants.

These examples redefine the problem that is the focus of government intervention. Emphasis is shifted from the immediate conduct that produces socially unacceptable results to a broader system of practices and incentives. These examples also involve some major institutional innovations in the form of government intervention that could generate appropriate modifications in that broader system. Redefinition of the problems often will require government to create, by subsidies or by altered regulatory rules, the market demand necessary to "carry" the desired social innovation. However, institutional conservatism thwarts the realization of such opportunities.

III

INNOVATION UNDER THE PRESENT REGULATORY SYSTEM

Part III will explore to what extent Congress and administrators have considered the impact of regulation on market and social innovation in the design and implementation of programs. It also will examine the impacts that regulations have had on market and social innovation.

A. Market Innovation: Current Regulatory Programs

1. Congressional and Administrative Concerns

With limited exceptions, Congress and administrators have not been much concerned with market innovation in designing and implementing regulatory programs. As developed in Part I, the dominant concerns of the present regulatory system are enforcement, uniformity, and avoidance of disruption. Pursuit of these goals often hinders incentives for market innovation, but with the exception of chemical regulation, Congress has paid little heed to such effects. In air and water pollution control, the burdens of regulation have been conceived pri-

marily in terms of compliance outlays, plant shutdowns, and disruption of established consumption patterns. The typical pattern of the last ten years has been for Congress to pass stringent measures and then, as compliance burdens appeared, to relax those measures by extending deadlines, providing waivers, and giving administrators discretion to postpone compliance.[91] The effects of relaxing command-and-control measures on market innovation are unclear. Reducing compliance outlays and providing more flexibility encourage market innovation, but easing regulatory burdens on economically marginal plants may reduce new plant investment and retard market innovation.

Recently, the EPA has become sensitive to the disincentives to new investment created by air and water pollution controls. The trade-off policy promulgated by the EPA in 1975 to permit new industrial development in nonattainment regions attempted to soften the inhibitory effect of command-and-control regulation on new plant investment.[92] The EPA's "bubble" policies also are designed to moderate the impact of regulatory requirements on investment by permitting emissions from an entire plant or industrial complex to be aggregated.[93]

Automotive safety and fuel economy legislation provides no record of congressional concern with market innovation as such. Limited concern that testing requirements might inhibit development of new chemicals is reflected in the Federal Insecticide, Fungicide, and Rodenticide Act Amendments of 1972 and the Toxic Substances Control Act provisions exempting experimental users of new chemicals from testing

91. For example, the federal role in industrial air and water pollution control expanded dramatically from rather limited programs in the mid-1960's to sweeping and ambitious regulatory measures adopted by Congress in the early 1970's. The 1977 amendments to the Federal Water Pollution Control Act and the Clean Air Act, *see* note 9 *supra*, tightened regulatory requirements in some areas, including control of toxic water pollutants and restriction of additional pollution in clean air areas. However, the amendments relaxed the stringency of existing provisions in many other respects through compliance deadline extensions and waiver provisions. *See generally* R. STEWART & J. KRIER, *supra* note 6, at 501-04, 532-35; Davis, Kurtock, Leape & Magill, *The Clean Air Act Amendments of 1977: Away from Technology Forcing?* 2 HARV. ENVT'L L. REV. 1, 37-38, 42-47 (1978).

The federal program of motor vehicle emissions control has shifted from 1965 legislation giving federal regulators broad discretion to develop control requirements based on technical feasibility and cost, to 1970 amendments mandating a 90% reduction in emission within five years regardless of cost, to later amendments postponing deadlines and giving administrators more flexibility in stringency, timing, and sanctions. *See* R. STEWART & J. KRIER, *supra* note 6, at 406-36.

92. *See* R. STEWART & J. KRIER, *supra* note 6, at 593-95. The trade-off policy was endorsed by Congress in the 1977 Clean Air Act amendments, *see* note 9 *supra*.

93. This approach permits pollution increases from new or modified sources within a plant or complex to escape full compliance with burdensome regulatory clearance and control requirements that apply to new or modified sources so long as compensating reductions are made in emissions or effluents elsewhere within the same plant or complex. Courts have, however, invalidated portions of EPA's "bubble" policy as inconsistent with the Clean Air Act. *See* Alabama Power Co. v. Costle, 13 Envir. Rep. (BNA) 1225 (D.C. Cir. 1979); Asarco v. EPA, 578 F.2d 319, 327-29 (D.C. Cir. 1978).

requirements.[94] These statutes also allow partial reimbursement for an innovator's testing costs by competitors who rely on the innovator's test data to secure regulatory clearance of similar products.[95]

2. *Impacts of Regulation on Market Innovation*

With the exception of the "resource diversion" studies discussed below, empirical work on the impact of regulation on market innova-

94. 7 U.S.C. § 136c (Supp. III 1979) (experimental use); 15 U.S.C. § 2604(h)(1) (Supp. III 1979) (test marketing).

95. On the one hand, requiring manufacturers seeking regulatory clearance of a "me too" chemical product to duplicate the testing performed by the pioneer manufacturer of the product could retard the diffusion of a new product innovation. On the other hand, allowing competitors to rely upon the first manufacturer's tests to secure regulatory approval of the "me too" product would reduce expected return on investment in the development of new chemicals. A compromise was adopted allowing use of an innovator's test data by "me too" competitors, but requiring them to share some of the testing expenses.

Different premises about the dynamics of market innovation in the pesticide industry were advanced by the two Senate Committees that reported the 1972 revision to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). *See* note 9 *supra*. The Commerce Committee contended that the first firm to register a new pesticide enjoys significant lead time and marketing advantages over subsequent entrants and that these advantages provide sufficient incentives for the invention of new chemicals even if subsequent entrants can rely on the first firm's test data. Small firms can afford to compete only if they can avoid bearing the total cost of testing. S. REP. No. 970, 92d Cong., 2d Sess. 80, *reprinted in* [1972] U.S. CODE CONG. & AD. NEWS 4096-103.

The competing viewpoint, advanced by the Agriculture and Forestry Committee, was that an exclusive use provision probably would not result in duplicative testing because subsequent registrants would pay the original registrant for the use of its test data. Without the power, based on the right of exclusive use, of an innovator to negotiate for sharing of test costs, the Committee believed that firms would be unwilling to invest substantial amounts in research and development. S. REP. No. 838, 92d Cong., 2d Sess. 16, *reprinted in* [1972] U.S. CODE CONG. & AD. NEWS 3993, 4034 [hereinafter cited as S. REP. No. 838].

The compromise measure ultimately enacted provides that data submitted in support of an application shall not, without permission of the applicant, be considered by the administrator in support of any other application for registration unless "the applicant has made an offer to compensate the original data submitter." 7 U.S.C. § 136a(c)(1)(D)(ii) (Supp. III 1979). The administrator is empowered to set compensation if the parties cannot agree.

While disagreeing about the impact of an exclusive use provision, both committees assumed that new pesticides were better pesticides. Eliminating the exclusive use provision was seen by the Commerce Committee as a method for stimulating the widespread manufacture and sale of better and safer pesticides. Concern that "potentially important pesticides [would] never [be] developed" prompted the Agriculture and Forestry Committee to oppose the exclusive use approach. S. REP. No. 838, *supra*, *reprinted in* [1972] U.S. CODE CONG. & AD. NEWS 3993, 4040. Neither committee articulated the reasons why new products would be safer or better.

The Toxic Substances Control Act (TSCA), *see* note 9 *supra*, extended much of the FIFRA screening approach to other hazardous substances. Concern over the effect of clearance and testing requirements on market innovation was similar to that shown for FIFRA, and a similar compromise was enacted. *See* 7 U.S.C. § 136a(c)(2)(B) (Supp. III 1979); H.R. REP. No. 1341, 94th Cong., 2d Sess. 44 (1976).

The desirability of new products was universally assumed in the TSCA debates. *See id.* at 5. Yet, like FIFRA, the assumption that safer chemicals would emerge was never supported in any detailed manner. 122 CONG. REC. 8282 (1976) (remarks of Sen. Tunney), *reprinted in* HOUSE COMM. ON INTERSTATE AND FOREIGN COMMERCE, LEGISLATIVE HISTORY OF THE TOXIC SUBSTANCES CONTROL ACT, 95th Cong., 2d Sess. 209 (1976).

tion has been extremely limited. In the absence of abundant empirical work, this Article analyzes the linkages among particular regulatory programs, firm investment decisions, industry structure, and innovation, and then seeks to predict their net impact. These relationships are developed below by reference to the four elements of regulation previously identified as significantly affecting innovation—compliance and decisional outlays, technical constraints, delay, and uncertainty. The available empirical evidence indicates that regulation has had an appreciable negative impact on market innovation and productivity but that the negative impact of regulation on productivity is substantially less than that exerted by other factors, such as the changing work force composition and erosion of incentives for capital formation.

a. Compliance and Decisional Outlays

The outlays required to ascertain and meet regulatory requirements affect market innovation and production in several ways. Resources (labor and capital) devoted to compliance with regulatory requirements might otherwise be invested in products or processes yielding market benefits to firms that are measured as output in national income accounts. This resource diversion would include the displacement of investment in innovations that would increase market output. Investment in regulatory compliance, on the other hand, generally does not increase a firm's measured output of goods and services. To the extent that resources devoted to regulatory compliance displace resources devoted to market production, measured output per unit of input will decline. This premise underlies a number of recent studies undertaken by economists that have attempted to correlate variations in regulatory compliance expenditures with the rate of increase of labor productivity. These studies present the best available quantitative evidence concerning the impact of regulation on productivity and, indirectly, on market innovation.[96]

If the economists' diversion thesis is correct, market innovation could be increased by making regulation more cost effective or by reducing its stringency.[97] Compliance outlays over the past decade in the

96. Imposition of stringent regulatory requirements on a given industry might actually increase innovation if (1) the opportunities for innovation in that industry are low, and (2) regulatory requirements discourage internal reinvestment of retained earnings that otherwise might occur and thereby channel those earnings into other, more productive investments.

97. Reliable compliance expenditures are difficult to obtain, in part because of allocation problems. For example, what percentage of the capital cost of a new plant designed to achieve pollution control standards should be allocated to regulatory requirements? Furthermore, labor productivity is a highly imperfect surrogate for market innovation. The output per person-hour or per person is only a partial measure of productivity, which in its most general form measures the ratio of output to all factor inputs. Changes in inputs over time (*e.g.*, variations in labor quality) are difficult or impossible to put a numerical value on. Conventional measures of productivity

fields of regulation examined here have been substantial, particularly in industrial air and water pollution control and automotive regulation.[98] The resulting impacts on innovation and productivity are discussed in detail in Haveman's recent review and analysis of the resource diversion studies. Haveman estimates that environmental, health, and safety regulation is responsible for seven to twelve percent of the fall in the annual rate of labor productivity increase, from nearly three and a half percent in the two decades following World War II to little better than one percent in recent years.[99] Haveman concludes that several factors other than regulatory compliance expenditures are more significant in accounting for the slowdown in productivity growth, contrary to the view espoused by some critics of regulation. These other factors include the changing composition of the work force (more young and less experienced workers); disincentives to capital formation and new investment attributable to inflation, general economic uncertainty, and government economic and tax policies; and the economy's adjustment to higher energy prices.[100] This general conclusion has been confirmed in the specific field of pesticide regulation by a recent study that found that the Federal Insecticide, Fungicide, and Rodenticide Act[101] had not had any major adverse impact on research and de-

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also may fail to capture product improvements. For these and other reasons, labor productivity changes do not accurately reflect changes in productivity knowledge embedded in new products and processes—the ultimate, but in many ways unquantifiable, definition of innovation.

98. Air and water pollution regulations often impose greater compliance burdens on industries or industry subgroups better able to "afford" compliance costs. These industries are likely to have higher than average growth rates and profits. Studies suggest that they are likely to spend more on research and development that yields innovative products and processes. *See generally* TECHNOLOGICAL INNOVATION, *supra* note 71. If so, loading compliance costs on these industries will stifle innovation. This effect would presumably be caught by diversion studies, but no studies have documented its magnitude.

99. *See* text accompanying note 1 *supra*. The economists' studies were aimed primarily at determining aggregate effects. Even if the impact of regulation on innovation and market productivity is relatively modest from the perspective of the economy as a whole, it may be significant in particular industries or sectors. Compliance outlays and other regulatory burdens are unevenly distributed. Industries such as automobile manufacturing, steel, and nonferrous metals have been disproportionately burdened, largely because they are responsible for a disproportionate amount of environmental and other problems. The impact on market innovation and productivity in those sectors is also likely to be disproportionate. *See* R. Crandall, Pollution Controls and Productivity Growth in Basic Industries (1979) (paper prepared for Conference on Productivity Measurement in Regulated Industries, Graduate School of Business Administration, University of Wisconsin, Madison), *discussed in* HAVEMAN REPORT, *supra* note 1, at 35-37.

100. *See* HAVEMAN REPORT, *supra* note 1. The Haveman conclusion encompasses the impact of occupational health and safety regulation, a regulatory program not examined in this Article. *See also* Malkiel, *Productivity—The Problem Behind the Headlines*, 57 HARV. BUS. REV. 81, 83 (1979). Other possible elements in productivity slowdown include a decline in technical opportunities and economies of scale, shifts in the composition of output (from goods to services), and a decline in the work ethic.

101. *See* note 9 *supra*.

velopment efforts, innovation, and sales.[102] The available studies indicate that the cure to lagging productivity lies principally in tax and macroeconomic policies designed to encourage capital formation, rather than a massive scaling down of social goals.

The diversion studies are, however, an imperfect guide to regulatory policy because they suffer from serious limitations. On the one hand, they fail to capture many benefits of regulatory programs because productivity is based on market-type measures of output that do not adequately reflect the social benefits of a cleaner, healthier, and safer environment. If these benefits were included in output measures, the impact of regulation on productivity in many cases might well be positive.[103]

On the other hand, the studies also fail to measure specifically many of the ways, other than diversion of investment dollars through compliance outlays, that regulation might impede innovation and productivity. For example, the studies do not address the potential interplay between regulation, market structure, and innovation.[104] They do not deal adequately with costs involved in diverting scarce management and research personnel resources to regulatory compliance efforts.[105] Most important, the studies fail to deal with other important categories of costs attributable to opportunities foreclosed or foregone as a result of regulation.[106]

The greater compliance burdens imposed on new plants and products are an example of these invisible opportunity costs. If investments in new plants and products are undertaken despite these burdens, the

102. CONSERVATION FOUNDATION, *supra* note 7, at E-1 to E-4.

103. If the processes or devices required to satisfy regulatory requirements are supplied from outside the industry, social regulation will create new markets for innovation in supplier industries. However, since diversion studies do not count a firm's internal investments to comply with regulatory requirements as contributing to productivity, perhaps sales by supplier industries to regulated industries should not count for that purpose.

104. Compliance and decisional outlays may impose a relatively greater burden on small firms, because outlays such as testing costs are not proportional to product sales or process size and because larger firms can benefit from economies of scale in coping with regulatory requirements. Regulation of chemicals, for example, has put a disproportionate burden on smaller firms. *See* CONSERVATION FOUNDATION, *supra* note 7, at IV-12 to IV-16. By encouraging industry concentration and entry barriers, compliance and decisional outlays may at the same time promote innovation under the Schumpeterian thesis, *see* J. SCHUMPETER, *supra* note 84, that large firms with market power are more likely to invest in longterm research and development. *See also* F. SCHERER, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 346-78 (1970).

105. *See, e.g.*, E. DENISON, ACCOUNTING FOR SLOWER ECONOMIC GROWTH: THE UNITED STATES IN THE 1970'S 129-30 (1979).

106. Some studies acknowledge the potential significance of opportunity costs other than those attributable to expenditures for installation and operation of health, safety, and environmental controls, but forego any effort to quantify them because of data limitations. For example, *see id.* at 129-31, which notes the potential importance of regulatory "diversion of executive attention" and delay of new projects but concludes that any attempt to estimate their magnitude would be wholly speculative.

adverse impacts of compliance costs on innovation may be captured by the diversion studies. But if firms decide against such investment because decisional and compliance costs render them unprofitable, the adverse impact on innovation presumably would not be captured in diversion studies. Technical constraints, delay, and uncertainty impose other invisible opportunity costs.

b. Technical Constraints, Delay, and Uncertainty

Command-and-control regulations constrain the design and technical characteristics of the products or processes regulated. The constraints may be especially severe when a given firm or industry is subject to multiple regulatory requirements. If the multiple constraints simply increase manufacturing or operating outlays they will be captured in diversion studies, but if these constraints cause firms to forego investment in otherwise promising new processes or products, the effects on market innovation would not be captured. The magnitude of such effects is highly uncertain, although regulated firms have frequently complained of the chilling impact of technical constraints.[107] The current regulatory system is ill equipped to ameliorate these impacts because it relies heavily on uniform standards and formal decisional processes.

Decisional delay and uncertainty may deter investments by creating a risk that a project will not receive regulatory approval and by postponing—and therefore effectively reducing—return on investment even if the project is approved. These opportunity costs are notoriously difficult to measure, and are not addressed by the diversion studies. The current system of regulatory decisionmaking, including relatively formal, protracted rulemaking procedures and extended judicial review, creates substantial uncertainties.[108] Delay and uncertainty may be compounded when a new investment is subject to multiple regulatory requirements.[109] One study indicates that delay may have a signif-

107. Circumstantial factors suggest that the inhibitory effect of technical constraints may be substantial. Regulators have little or no concern with market innovation as such. They want regulatory requirements that can be easily enforced, survive legal challenge, and minimize information and decisionmaking costs. Furthermore, the current decisionmaking process is not geared to take into account the impacts of technical constraints on innovation. Regulators have limited experience with the opportunities and problems confronting regulated firms. Under the present formal decisionmaking processes, regulators may have difficulty verifying industry claims that proposed regulatory actions will involve severe technical constraints. Agencies may tend to discount such claims as adversary posturing.

108. *See* Dunlop, *What the Medical Industry Should Learn from the Regulatory Process Elsewhere*, 54 J. MED. EDUC. 3 (1979); Schunck, *Litigation, Bargaining, and Regulation*, REG., July/Aug. 1979, at 26, 28.

109. However, this delay and uncertainty is largely attributable to regulated firms that challenge the legality or soundness of agency positions through administrative proceedings or judicial review. *See* Note, *supra* note 77, at 1725-26.

icant adverse effect on innovation in pesticides, particularly for small firms.[110] Loud, but largely unverified, testimony from regulated firms in other fields has emphasized the inhibitory effects of regulatory delay and uncertainty on innovation.

Like compliance burdens, regulatory constraints, delay, and uncertainty are likely to fall more heavily on new products and processes. Furthermore, regulatory measures may inhibit new investment simply because managers *believe* that controls will have an adverse impact. Business perceptions of regulatory hostility to new investment can thus be self-fulfilling.

3. *Summary: The Significance and Role of Market Innovation Impacts in Regulatory Programs*

If the diversion thesis is correct, measured compliance outlays may serve as a rough proxy for innovation investment foregone. However, the diversion thesis fails to account for many of the opportunity costs arising from the greater burdens imposed on new plants and products and from technical constraints, delay, and uncertainty. These opportunity costs have until recently attracted little attention, although Congress and regulators have shown greater concern for compliance outlays. While health, safety, and environmental regulation contributes to the national well-being in important ways not captured by conventional measures of productivity and output, its contribution to productivity lag is not insubstantial. Because other factors contributing to declining productivity—such as changing work force composition—may be less easy to correct even though they are quantitatively more important, Congress must give explicit consideration to market innovation in framing and implementing regulatory programs.

Prescriptions for changing regulatory mechanisms to reduce their adverse impact on market innovation must remain general because of our limited understanding of the relationship between regulation and market innovation. But, at a minimum, Congress and regulators should seek to reduce compliance outlays, permit firms maximum technical flexibility in achieving regulatory objectives, avoid imposing disproportionately heavier compliance costs on new products and processes or on industries with higher profits, and reduce the uncertainties associated with regulatory requirements and the costs and delays associated with regulatory decisionmaking.

These objectives are often in conflict. Moreover, the contribution of any such changes to market innovation will be difficult to determine; accordingly, such changes may be acceptable only if they do not sub-

110. CONSERVATION FOUNDATION, *supra* note 7, at IV-12 to IV-16.

stantially undermine the premises of the present regulatory system or if they serve other major social objectives. The discussion in Part V of alternative tools and decisional processes will elaborate on these considerations.

B. Social Innovation: Current Programs

Very little research or analysis has been devoted to determining the impact of current regulatory programs on social innovation. Neither line agencies such as the EPA nor staff-level agencies, such as the Council on Environmental Quality (CEQ), have collected the necessary information. Congress has made no systematic effort to monitor the current system of regulatory tools and decisional processes to assess their effect on social innovation. What follows is therefore impressionistic. But regulatory programs clearly have fallen far short of ambitious technology-forcing goals. More effective incentives for the development and adoption of environmentally superior processes and products are needed to improve or even to maintain environmental quality in the face of economic growth.

1. Technology-Forcing Strategies in Existing Regulation

The available evidence of the impact of regulation on social innovation for chemicals, automobiles, and industrial sources suggests two main findings: (1) regulation has promoted diffusion of state-of-the-art technology rather than technological invention and (2) regulation has fallen short of ambitious technology-forcing goals, partly because the process of regulatory standard setting leads administrators to base standards on existing technologies and partly because the regulatory system does not provide sufficient incentives for invention.

a. Culling: Regulation of Chemicals

Chemical regulation is premised on the theory that exclusion of environmentally unacceptable products from the market will lead manufacturers to develop socially superior products. Experience under the Federal Insecticide, Fungicide, and Rodenticide Act,[111] however, is difficult to assess.[112] Pesticide manufacturers have expanded research and development efforts significantly over the past decade; many new chemicals have been developed, partly in response to regulatory considerations; and management and research personnel have become more sensitive to health and environmental considerations.[113] But the decade has seen little stimulus for the development of innovative ap-

111. *See* note 9 *supra*.

112. Experience under the Toxic Substance Control Act, *see id.*, is too preliminary to assess.

113. CONSERVATION FOUNDATION, *supra* note 7, at IV-1 to IV-20.

proaches, such as integrated pest management, for dealing with agricultural pests; and pest resistance to chemicals remains a continuing problem.[114] Total pesticide sales quintupled from 1967 to 1978,[115] but no evidence indicates whether the social performance of pest control measures has improved as a result of regulation. A culling strategy, which focuses on case-by-case decisions, may overlook the cumulative impact of such decisions on innovation and the overall performance of the product category being regulated. Proponents of innovative approaches have claimed that the EPA has in the past been ill prepared to process them for regulatory approval. However, the more substantial barriers to new approaches appear to lie in the cost advantages enjoyed by broad-spectrum chemicals,[116] farming practices, and the difficulties in getting information to farmers that would encourage the use of alternatives.

b. Technological Transformation: Industrial Sources

Both the Clean Air Act[117] and the Federal Water Pollution Control Act[118] require that new industrial sources incorporate "best available" pollution control technology.[119] These state-of-the-art requirements reflect two basic congressional premises. First, Congress assumed that making new-source requirements increasingly strict was the only way to achieve longrun progress in reducing net amounts of air pollution in the face of continued economic growth.[120] Second, Congress assumed that state-of-the-art requirements would ensure that pollution control technologies would not be frozen at present levels. By guaranteeing a market for new control technologies, such a provision

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114. *See id.* at I-9 to I-10.

115. The sales (in current dollars) of domestic pesticide manufacturers rose from $638 million in 1967 to $3,369 million in 1978. *Id.* at C-8.

116. *See id.* at IV-40 to IV-48.

117. *See* note 9 *supra*.

118. *Id.*

119. New source performance standards contained in § 111 of the Clean Air Act are designed to reflect the degree of emission reduction achievable through the application of the best system of continuous emission reduction. 42 U.S.C. § 7411(a)(1)(C) (Supp. III 1979). Standards of performance for new sources in 27 industrial categories are mandated by § 306 of the Federal Water Pollution Control Act to reflect "the greatest degree of effluent reduction which the Administrator determines to be achievable through application of the best available demonstrated control technology." 33 U.S.C. § 1316(a)(1) (1976).

120. A National Academy of Science report, cited in the legislative history of the Clean Air Act Amendments of 1977, concluded:

> Many foreseeable problems cannot now be solved by available technology. Even if we control 99.5 percent of some pollutants, the remaining one-half of one percent, because of large absolute amounts projected by the year 2000, can create environmental problems for which a workable remedy has not yet emerged from the laboratory.

H.R. REP. NO. 294, 95th Cong., 1st Sess. 191, *reprinted in* [1977] U.S. CODE CONG. & AD. NEWS 1077, 1270.

would, at a minimum, mean that industrial sources would adopt whatever improvements came from the private sector. The guaranteed market theory was also expected by some to stimulate innovation by assuring vendors of new technologies a market for their products. State-of-the-art requirements might also be used by regulators to advance the development of new technologies by setting standards requiring performance slightly superior to that achievable under the existing state of the art.[121]

The Clean Air Act (CAA) and the Federal Water Pollution Control Act (FWPCA) have adopted different strategies for existing industrial services. Under the CAA Amendments of 1970, controls on such sources were required to achieve by 1975/1977 uniform federal health-based ambient standards established without reference to compliance cost.[122] If the standards were not met, sources were to be required to curtail emissions or to shut down. Technical or economic infeasibility was not a defense to emission reduction requirements. This approach supposedly would force the invention and adoption of new control technologies.[123] New sources also were required to comply with ambient standards or, in PSD (prevention of significant deterioration) areas, with increments limiting the extent of increase in existing ambient pollution concentrations.[124]

In contrast to the 1970 CAA Amendments, the 1972 FWPCA Amendments deliberately rejected federal ambient standards as a basis for water pollution control regulation and relied directly upon nationally uniform, technology-based effluent standards to be established industry-by-industry and applied to all sources in an industry.[125] The strategy is to diffuse state-of-the-art control technology nationwide, regardless of the environmental quality benefits of employing it in a given location. Adoption of this strategy reflected Congress' fear of the potential for delay and obstruction of enforcement efforts under an ambient approach, which requires that ambient standards first be adopted and then translated via complex analytical models into source-by-source effluent limitations.[126]

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121. This interpretation accords with a Senate Report, which concluded that the best available control technology need not "be in actual, routine use somewhere." S. REP. No. 1196, 91st Cong., 2d Sess. 16 (1970).

122. Clear Air Act §§ 109(a), (b), 110(a)(2)(A), 110(e), 42 U.S.C. §§ 7409(a), (b), 7410(a)(2)(A), 7410(e) (Supp. III 1979).

123. *See* Union Electric Co. v. EPA, 427 U.S. 246 (1976).

124. Clean Air Act §§ 160-169, 42 U.S.C. §§ 7470-7479 (Supp. III 1979).

125. Federal Water Pollution Control Act (FWPCA) Amendments of 1972 § 301(b), 33 U.S.C. § 1311(b). In 1977, amendments to the FWPCA renamed the entire Act the Clean Water Act. Pub. L. No. 95-217, 91 Stat. 1566 (current version at 33 U.S.C. § 1311(b) (1976)).

126. The FWPCA strategy also reflected Congress' desire to ensure equal treatment of competitors in order to discourage industrial relocation. The effluent standards were to be imposed in

The CAA strategy of forcing technology to achieve health-based ambient standards has failed to achieve its stated objectives. In many regions, the original deadlines for compliance have long since passed, and ambient pollutant levels still greatly exceed the standards. This failure reflects a number of factors. First, the relationship between emissions and air quality has been poorly understood, and the Act's region-by-region approach to control of plans has not been effective in dealing with interregional transport of pollutants.[127] Second, EPA through administrative actions and Congress through the 1977 Amendments granted waivers or postponements of control requirements when compliance problems surfaced and threatened economic disruption. Concern over industrial disruption has generally proven more powerful than technology-forcing logic. Moreover, the health-protection rationale of the system has, for several reasons, not supported drastic enforcement action.[128] Ambient standards and prevention-of-significant-deterioration increment requirements may have motivated new sources to innovate in reducing emissions so that they could locate in airsheds where air quality measures limit additional pollution. But for existing sources, the history of postponements, coupled with the fact that many of the more substantial investments for air pollution control by existing sources have involved relatively familiar technology, suggests that the Act has operated as a technology-based regulatory system, with the burden on government to show that technology is "available" to achieve the performance requirements it seeks to enforce.[129] Achieve-

two stages. The first required adoption by 1977 of "best practicable technology"—roughly equal to the average performance of the better controlled plants in the industry. The second stage required adoption by 1983 of "best available technology" (BAT)—equivalent to the performance of the best controlled plant in the industry. BAT control requirements would be roughly equivalent to those required for new sources in the same industry under new source pollution standards. The 1977 FWPCA Amendments retained this basic state-of-the-art approach while postponing compliance deadlines. The amendments adopted provisions relaxing some requirements of uniformity through waivers and differentiating several general categories of pollutants and corresponding effluent standards. *See* R. STEWART & J. KRIER, *supra* note 6, at 505-36.

127. *See, e.g.*, Cleveland & Graedel, *Photochemical Air Pollution in the Northeast United States*, 204 SCIENCE 1273 (1979).

128. The scientific justification for the ambient standards is fuzzy and disputed; the abatement burden of meeting the standards is usually distributed among a number of sources, often somewhat arbitrarily. The relationship between ambient air quality and particular firms' emissions is determined by more or less arbitrary diffusion models.

129. *See* La Pierre, *supra* note 31. Emission and effluent standards under § 112 of the Clean Air Act and §§ 301 and 307 of the Federal Water Pollution Control Act, *see* note 9 *supra*, which are designed to control toxic pollutants but are not based on ambient standards, have also, in practice, operated as technology-based standards. *See* W. RODGERS, HANDBOOK ON ENVIRONMENTAL LAW 483-88 (1977); La Pierre, *supra* note 31, at 798-805. The toxic pollution control provisions of § 307 of the 1972 FWPCA appeared to constrain or exclude consideration of costs and technological feasibility in setting effluent limitations for toxics. The rigidity made EPA reluctant to invoke § 307 at all. A negotiated settlement instituted by environmentalists led to a system of technology-based emission standards—an approach ratified by Congress in the 1977

ment of the ambient standards in many nonattainment areas will require greatly increased control by existing sources, which will involve sharply increased costs unless the state of the art of control technology improves or existing sources are replaced by new sources with greatly improved emissions performance.[130]

A third reason for nonattainment lies in design defects or inadequate operation and maintenance of control process or equipment.[131] Installation of capital intensive control equipment—the principal thrust of regulatory strategies to date—does not guarantee compliance. To ensure proper operation and maintenance, administrators must significantly improve monitoring and enforcement techniques.

Both the CAA[132] and the FWPCA[133] embody a system of explicitly technology-based standards for new sources, and the FWPCA also follows this approach for existing sources. No data is available to show whether this strategy has stimulated invention as opposed to diffusion of relatively well-developed technologies.

However, an examination of the regulation-writing process suggests that the principal thrust is diffusion. In theory, courts have acknowledged the technology-forcing character of new source performance standards and "best available technology" effluent limitations. Courts have stated that the EPA may anticipate the evolution of the state of the art and need not show that technology to achieve the required performance levels is actually in use, so long as the agency can support its prediction that the requisite technology will become available under the pressure of the standard.[134] In practice, this showing is difficult to make, given a rulemaking procedure in which the EPA must disclose its data and analysis, meet the criticisms of industry, and survive a "hard look" standard of review.[135] The EPA has therefore tended to base standards on general control technologies actually in use.[136]

FWPCA Amendments. *See* W. RODGERS, *supra*; R. STEWART & J. KRIER, *supra* note 6, at 534. The standards require regulated industry to meet the maximum degree of control achievable with "available" technology. The degree of compliance burden may be implicitly correlated to the perceived severity of health risk.

130. *See* W. DRAYTON, A TOUGHER JOB REQUIRES SMARTER REGULATION (Jan. 1981) (EPA pamphlet).

131. *See "Complying" Plants Exceed Air Limits by 25 Percent, Drayton Tells Chamber*, 11 ENVIR. REP. (BNA) 5 (1980) [hereinafter cited as *Drayton*].

132. *See* note 9 *supra*.

133. *Id.*

134. *See, e.g.*, Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 391-92 (D.C. Cir. 1973), *cert. denied*, 417 U.S. 921 (1974).

135. *See id.* at 392-402.

136. *See* La Pierre, *supra* note 31, at 790; RFF & URBAN INSTITUTE, ENVIRONMENTAL REGULATION IN THEORY AND PRACTICE: EPA'S PROCESS OF SETTING BEST PRACTICABLE CONTROL TECHNOLOGY STANDARDS 3-5, A15 (1978) (Nat'l Bureau of Standards Report). Some evidence

Sometimes the EPA has been able, within the context of technology-based standards, to advance the state of the art in pollution control through its own research and development efforts. For example, EPA-funded research and development played a major role in improving flue gas desulphurization scrubber technology and has promoted innovations in boiler design that promise substantial reductions in nitrogen oxides. When the results of such efforts are incorporated into regulatory requirements, they can "force" technology.[137] However, EPA research and development funds are limited. External supply strategies are also limited by the need for cooperation of the regulated industry in adapting technology to reliable operation on a commercial scale.[138]

Having most pollution control standards based on demonstrated "availability" and economic "affordability" of specific control technologies obviously undercuts technology-forcing potential. It also has important implications for regulatory decisionmaking. Such an approach depends on accurate resolution of complex industry-by-industry engineering and economic questions. Regulatory agencies face serious difficulties in developing the information, experience, and analytical resources to resolve such questions in a way that will survive "hard look" judicial review.

c. Technological Transformation: Motor Vehicle Regulation

Congress has pursued substantially different strategies for improving the social performance of the automobile in three areas: safety, air pollution emissions, and fuel economy. The most dramatic innovations have occurred with fuel economy, but these changes may be largely attributable to market forces. Air pollution control has achieved substantial improvements despite relatively modest technological invention.

i. Motor vehicle safety standards and research and development. The National Traffic and Motor Vehicle Safety Act of 1966[139] sought to enhance auto safety through a regulatory system based upon performance standards and an ambitious research and development program.[140] Performance standards were prescribed by Congress because

indicates technology-based standards do encourage innovation to lower the costs of meeting the required level of performance. Ashford & Heater, *Regulation and Innovation*, 5 EPA J., Sept. 1979, at 32, 33-34. However, the practice of linking the stringency of regulatory requirements to the regulated industry's capacity to "afford" such controls may undercut these incentives. If industry demonstrates the ability to meet existing control requirements at less cost, the agency may simply increase the stringency of control requirements.

137. *See* Note, *supra* note 77, at 1723-25.

138. *See id.* at 1729.

139. *See* note 9 *supra*.

140. The notion that "safety doesn't sell" was discussed extensively in the legislative history

of the flexibility that standards presumably allowed the manufacturer in choosing materials and specifying actual design.[141] The Act also envisaged an ambitious automobile safety research and development program that would enable the government to develop "major independent technical capability."[142]

The National Highway Traffic Safety Administration (NHTSA) in the Department of Transportation has assumed responsibility for implementation. The legislature expected that auto manufacturers would develop diverse technologies to meet the required level of safety performance. However, NHTSA must use an administratively feasible standard-setting process and must be able to defend its standards on judicial review. These considerations have often led NHTSA to base standards on available technologies.[143] Manufacturers have had little incentive to invent new technologies and at the same time have been in a strong position to question the feasibility of any NHTSA proposals. For example, NHTSA was frustrated for years in promulgating standards for tire safety by a lack of technical know-how, which it finally overcame by hiring an individual who had spent most of his career as an executive of a tire manufacturing company.[144] The ambitious federal research and development program originally envisaged has never materialized.

ii. Automobile air pollution control. Congress in 1965 originally gave federal administrators broad discretion in setting air pollution

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of the Act. The Senate Commerce Committee did not pass judgment on whether this assertion was true, but found that industry officials believed it. The Committee concluded that this belief accounted for industry's failure to allocate adequate resources to safety engineering. S. REP. NO. 1301, 89th Cong., 2d Sess. 2, *reprinted in* [1966] U.S. CODE CONG. & AD. NEWS 2709, 2710. Congress concluded that voluntary industry standards, the approach utilized at the time, had "largely failed" to promote motor vehicle safety. *Id.* at 2709, 2717.

141. The Act, the Committee asserted, was "not intended or likely to stifle innovation in automotive design." *Id.* The Act instructed the Secetary to promulgate standards that were "practicable." 15 U.S.C. § 1392(a) (1976). Safety was intended to be the predominant consideration in a calculus that also included cost, feasibility, and lead time. A showing of economic hardship or engineering impossibility would quality a manufacturer for a one-year extension of any deadline. The Secretary was also given the discretionary power to grant a longer extension if the required changes could not reasonably be accomplished within one year. 15 U.S.C. § 1410 (1976). A flexible enforcement scheme, with a maximum civil penalty of $400,000 (now $800,000) for any related series of violations, was also included in the Act. Civil penalties could be adjusted "to the size of the business and the gravity of the violation." 15 U.S.C. § 1398(b) (1976).

142. S. REP. NO. 1301, 89th Coug., 2d Sess. 4, *reprinted in* [1966] U.S. CODE CONG. & AD. NEWS 2709, 2712. The Act authorized the Secretary to develop experimeutal vehicles through contract or grant. Elaborate provision for patent protection shows that Congress presumed the government could initiate innovations in the field. This research and development program had one major and one minor goal: to evaluate better the efforts of industry and to pioneer innovations in lieu of those efforts.

143. *See* Breyer, *supra* note 11.

144. *See id.*

emission standards for new automobiles. Dissatisfied with a perceived lack of progress, Congress in 1970 adopted a draconian technology-forcing strategy, requiring a ninety percent reduction from existing pollution levels for 1975/1976 model automobiles. The premise was that such requirements, backed up by stiff sanctions for noncompliance (up to $10,000 for each nonconforming auto) would force regulated firms to invest the necessary resources to succeed in developing the technology needed for compliance. Fear that this strategy would fail was, however, reflected in provisions for administrative waiver of deadlines. The original 1975/1976 deadlines for achieving ninety percent reductions have been repeatedly waived or statutorily postponed.[145]

The use of strict deadlines combined with waiver provisions or postponements reflects underlying uncertainty about technological advance. One view holds that the necessary technology can be developed readily and that technology-forcing requirements, backed by clear deadlines and stiff sanctions, will drive manufacturers to achieve what is already possible.[146] This view is tempered, however, with the sobering realization that the problems of mass producing a technology that exists only in experimental form have serious implications for automobile prices, consumer acceptance, fuel economy, and product warranties. Moreover, compliance with ambitious social goals may require more than simply adapting developed technologies for mass production. Basic inventions may be necessary to reduce air pollution and increase or at least maintain fuel economy.[147] Short deadlines may render development of innovative technologies infeasible. Therefore, deadline postponements and other forms of flexibility have been included to deal with these possibilities.[148]

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145. *See* R. STEWART & J. KRIER, *supra* note 6, at 406-38.

146. This view is often associated with distrust of the automobile industry's good faith. *See, e.g., Proposed Amendments to the Clean Air Act: Hearings on H.R. 4151, H.R. 4758, and H.R. 4444 Before the Subcomm. on Health and the Environment of the House Comm. on Interstate and Foreign Commerce*, 94th Cong., 1st Sess. 600 (1977) (statement of Rep. Maguire) [hereinafter cited as *Clean Air Act Hearings*].

147. *See* S. REP. No. 717, 94th Cong., 2d Sess. 59 (1976).

148. The 1977 Amendments to the Clean Air Act reflect substantial concern with such problems. Nitrogen oxides waiver provisions allow extra lead time to develop alternative technologies. 42 U.S.C. § 7521(b)(6)(A) (Supp. III 1979). The ultimate lack of faith in a $10,000 per vehicle penalty is acknowledged in provisions allowing flexibility in setting noncompliance penalties for heavy-duty vehicles, including adjustment of the penalty to the degree of noncompliance. 42 U.S.C. § 7525(g)(3)(C) (Supp. III 1979). The 1977 amendments include waivers for a limited number of vehicles employing "innovative power train technology or innovative emission control devices," which can be applied to mass production. 42 U.S.C. § 7521(b)(6)(A) (Supp. III 1979). The administrator is also required to promulgate regulations requiring each manufacturer to "build, and, on a regular basis, demonstrate the operation of vehicles" that meet ambitious research objectives in nitrogen oxides control. 42 U.S.C. § 5721(b)(6)(A) (Supp. III 1979). The latter strategy could be termed "research and development forcing," although its success has yet to be established. The amendments also recognize differences in the capabilities and structure of the

As a result of the repeated legislative and administrative postponements, the ninety percent reduction originally decreed in the 1970 Clean Air Act Amendments still has not been achieved. Despite a recent relaxation of the ambient standard for photochemical oxidant, serious violations of the standard are common in many urban areas. The principal response of the domestic manufacturers to regulations has been to adjust timing, recirculate exhaust gas, make other relatively minor modifications of the traditional internal combustion engine, and install add-on catalysts. These steps, which had been proposed or contemplated by the industry in the late 1960's, have substantially reduced emissions. However, the technologies are vulnerable to on-the-road deterioration, dismantlement, and catalyst poisoning.[149]

Whether one views this history as a success or a failure in technology forcing is a matter of perspective. If the purpose was to force the rapid commercialization and diffusion of add-on catalysts, and modifications to the standard internal combustion engine, the strategy succeeded. If the purpose was to achieve healthy air in Los Angeles or, as some sponsors of the legislation evidently contemplated, trigger basic changes in engine technologies, it failed. That failure, if it be such, reflects several factors: the noncredible character of the original $10,000 per car fine for failure to achieve the timetable; the oligopolistic character of the industry and the maturity of its technology, which means that a basic change in engine design would destroy the value of substantial amounts of invested capital and disrupt established supplier relations; the short deadlines originally imposed; the constant incremental adjustment of control requirements by the Congress and the EPA; and the failure to impose to any substantial extent retrofit requirements on existing vehicles.

Another factor that undercuts technology forcing emerges from decisions on deadline postponements. Although the Clean Air Act appeared to give manufacturers the burden of showing that technology able to meet the timetable is not available at reasonable cost and with acceptable performance characteristics, as a practical matter the burden has fallen on government officials to show that the technology is "available."[150] This shift reflects a perceived asymmetry in error costs: holding the industry to requirements that are unattainable threatens traumatic dislocation, while postponing an incremental control require-

various manufacturers. Certain waivers were included because "smaller manufacturers generally adopt technology [developed by] the major manufacturers." S. REP. No. 717, 94th Cong., 2d Sess. 59 (1976).

149. *See, e.g., EPA Renews Effort Under Air Act to Reduce Automobile Emission Tampering*, 10 ENVIR. REP. (BNA) 1252 (1979).

150. *See* International Harvester Co. v. Ruckelshaus, 478 F.2d 615, 648 (D.C. Cir. 1973); R. STEWART & J. KRIER, *supra* note 6, at 406-41.

ment that could have been met earlier involves modest costs, at least from the perspective of any single postponement decision.[151] The industry is in a strong position to question EPA claims that technology beyond the demonstrated state of the art is "available."

The record suggests that an arbitrary regulatory timetable backed by nominally severe sanctions may in practice operate as a system of incrementally adjusted technology-based requirements, under which the government has the burden of establishing that technology is "available" to achieve the performance that it mandates. This scheme offers regulated firms little positive incentive, and some significant disincentives, for invention of major social innovations.[152]

iii. Fuel economy standards. The Energy Policy and Conservation Act (EPCA)[153] specified fuel economy standards that would apply to the new car fleet average of each manufacturer for the model years 1978-1980 and 1985. The Act gave the Department of Transportation discretion to set standards for 1981-1984.[154] A modest provision for government-funded research and development also was included.[155]

The approach to technological transformation embodied in the Act is far more complex and sophisticated than that employed in the 1970 Clean Air Act Amendments for automotive emissions. The EPCA provision requiring achievement by 1985 of an arbitrary performance level (27.5 m.p.g.) appears at first glance similar to the ninety percent reduction requirements of the 1970 Clean Air Act Amendments. But the differences are important. The 1985 fuel economy goal

151. *See* International Harvester Co. v. Ruckelshaus, 478 F.2d 615, 648 (D.C. Cir. 1973); *see also EPA Waives 1981 Carbon Monoxide Rules for Chrysler, Citing Risks Facing Firm*, 11 ENVIR. REP. (BNA) 2192, 2193 (1980).

152. Presumably, however, the industry must make a showing of "good faith" in attempting to meet regulatory requirements in order to avoid more intrusive government regulation or intervention. *But see* R. STEWART & J. KRIER, *supra* note 6, at 434. The need to make such a showing may stimulate innovation by creating a market for suppliers, an incentive reflected by the participation of catalyst suppliers in EPA postponement decisions. But if basic changes in engine design are required, the need to substantiate claims for mass production experience, the possibility of manufacturer retaliation against suppliers, and the fickle character of regulatory incentives may undercut external suppliers' incentives.

153. *See* note 9 *supra*.

154. Pub. L. No. 94-163 § 501, 89 Stat. 871 (1975) (Part V codified in 15 U.S.C. §§ 2001-2012 (1976)), amending the Motor Vehicle Information and Cost Saving Act, 15 U.S.C. §§ 1901-2012 (1976).

155. The Senate bill, which included an ambitious program for developing a prototype vehicle, was limited sharply by the Conference Committee. S. CONFERENCE REP. No. 516, 94th Cong., 2d Sess. 161, *reprinted in* [1975] U.S. CODE CONG. & AD. NEWS 1956, 2002. Provision for certification and procurement of advanced automobiles was deleted "in light of the failure to utilize a similar authority under section 212 of the Clean Air Act." *Id.* at 164, *reprinted in* [1975] U.S. CODE CONG. & AD. NEWS 1956, 2002. Instead, the Committee urged a study of the subject and scaled down plans to develop a prototype vehicle. The notion that public efforts could pioneer innovation was largely abandoned.

had a firmer technological basis than the Clean Air Act requirements.[156] Moreover, EPCA provides considerable interim flexibility. The Secretary of Transportation is empowered to gear 1980-1985 performance levels to what is "feasible."[157] In determining feasibility, the Secretary can consider impacts of fuel economy requirements on other regulatory programs (air, safety, and noise) as well as technological and economic feasibility.[158] A system of "carry-backs" allows superior performance in one year to be credited against shortfalls in other years. EPCA's sanctions also depart from the draconian approach of the 1970 Clean Air Act Amendments. The EPCA provides graduated civil penalties of five dollars per car for every one-tenth m.p.g. deviation from the applicable fuel economy standards.[159] Flexibility is promoted because standards are based on the average performance of a manufacturer's fleet, and need not be met by each vehicle.

The last several years have witnessed substantial changes in vehicles designed to achieve increased fuel economy, including downsizing; smaller, more fuel-efficient engines; and electronic ignition systems. While none of these steps involves radical breakthroughs in the state of the art, each step represents a substantial shift over a short time and suggests that more significant modifications in automotive technology are likely in the future. These developments seem attributable largely to petroleum price increases and consumer concern over gasoline shortages, both of which have greatly stimulated demand for fuel-effi-

156. An EPA-Department of Transportation study concluded that the fuel economy goals were practical, assuming no major changes in other regulatory requirements. H.R. REP. No. 340, 94th Cong., 2d Sess. 86, *reprinted in* [1975] U.S. CODE CONG. & AD. NEWS 1762, 1848. Fuel economy can be promoted through a wide range of measures. It does not depend on breakthroughs in particular engine or catalyst technology. Radial tires, engine displacement, and the proportion of small cars in the fleet affect the performance of the manufacturer.

157. 15 U.S.C. § 2002(a)(3) (1976). This provision applies to heavy duty motor vehicles over the entire period.

158. If the Secretary of Transportation determines, upon application by a manufacturer, in any model year that new federal motor vehicle emission requirements could reduce the fuel economy of new motor vehicles, the Secretary must correspondingly reduce the fuel economy requirements. 15 U.S.C. § 2002(d) (1976). Similar waivers for penalties due to other federal regulations are available to individual manufacturers upon application. Congress also recognized that small manufacturers have significantly different capabilities than large manufacturers. Manufacturers of fewer than 10,000 vehicles annually can apply to the Secretary of Transportation for an exemption under which alternative fuel economy standards are tailored to the manufacturer's circumstances. 15 U.S.C. § 2002(c) (1976).

159. Waivers may be granted where necessary "to prevent a substantial lessening of competition." 15 U.S.C. § 2008(b)(3)(C) (1976). The House Interstate and Foreign Commerce Committee concluded that a regulatory scheme must not impose "impossible burdens [on the automobile industry]" or unduly limit "consumer choice on capacity and performance of motor vehicles." H.R. REP. No. 340, 94th Cong., 2d Sess. 87, *reprinted in* [1975] U.S. CODE CONG. & AD. NEWS 1762, 1849. Industry officials have complained, however, that the flexibility implied by graduated penalties is largely illusory, because manufacturers are reluctant to incur any penalties for fear of being labeled "law breakers."

cient cars. Fleet-wide fuel economy in each year has been appreciably above regulatory minimums, suggesting the dominance of market circumstances. Higher fuel prices have made existing cars less economically attractive and perhaps blunted the fact that new fuel-efficient cars are less attractive to many consumers because of their smaller size and lower power. However, regulation has probably been an important complement to the market forces favoring more fuel-efficient cars. Consumer demand for fuel-efficient cars has waxed and waned with fluctuations in gasoline availability and prices, creating uncertainty for manufacturers.[160] Regulatory requirements have provided an assured floor of "demand" for fuel economy that has encouraged manufacturers to commit billions to retooling. The greater credibility of sanctions which, unlike the Clean Air Act, are relatively modest and geared to the degree of noncompliance, may also be a factor in the apparent success of fuel economy standards.

2. *Alternative Approaches for Promoting Innovation in Existing Regulatory Statutes*

Existing statutes include a number of modifications and alternatives to the dominant technology-forcing approach. With certain exceptions, however, these alternatives have thus far not provided a major stimulus to social innovation.

a. *Waivers and Variances for Innovative Pollution Control Technologies*

Complicated waiver procedures for innovative control technologies were included in 1977 amendments to both the air and water pollution acts. They reflect concern that existing regulatory strategies may foreclose promising social innovations that would occur if firms had greater flexibility. But they also reflect the fear that waiver provisions might be exploited by industry as a method for delaying compliance. The second concern appears to dominate the existing provisions, which are hedged with restrictions based on the assumption that strict deadlines are better than too much flexibility.[161] To date, only a handful of

160. NATIONAL ACADEMY OF SCIENCES-NATIONAL ACADEMY OF ENGINEERING, THE COMPETITIVE STATUS OF THE U.S. AUTOMOBILE INDUSTRY 41-54 (W. Abernathy & K. Clark eds. 1981).

161. Seven-year waivers from otherwise applicable new source performance standards are available under § 111 of the Clean Air Act to new and modified sources that propose to use innovative abatement systems. The administrator of EPA must determine that the proposed control system (1) has not been adequately demonstrated, (2) has a substantial likelihood of achieving greater performance than existing technologies in terms of emissions, energy, or economics, and (3) will not pose an unreasonable health risk. 42 U.S.C. § 7411(j)(1)(A) (Supp. III 1979).

Variances for use of innovative control methods by existing sources are provided under § 113 of the Clean Air Act. 42 U.S.C. § 7413(d)(4) (Supp. III 1979). Existing sources planning to utilize

applications for waivers have been filed, and apparently none has been granted. The substantive limitations on relief and the delays involved in obtaining clearance are an obvious deterrent. This reluctance to grant waivers in advance for innovative technologies contrasts sharply with the greater willingness of the Congress and the EPA to relax regulatory requirements after compliance efforts have fallen short because of technological and cost barriers.

b. Subsidies and Guarantees

The 1972 Amendments to the Federal Water Pollution Control Act[162] authorized substantial federal subsidies for the construction of secondary treatment for municipal waste. Most of these funds have been expended for traditional end-of-pipe control projects that are over-capitalized, under-maintained, often ineffective, and sometimes environmentally damaging.[163] Promising new or unconventional technologies for secondary wastewater treatment, such as recycling or spray disposal, have been largely ignored, partly because administrators responsible for dispensing billions in funds are risk-adverse and because the construction contractors and engineers are often conservative.[164] The fact that political support for the program comes from construction interests is a major factor, as is federal administrative bias in favor of uniform solutions. Some steps to encourage alternative technologies were incorporated in the 1977 Amendments.[165] To date, these provi-

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new means of emission control are eligible for a maximum variance of five years provided they prove that the technology (1) would not likely be used otherwise, (2) is not adequately demonstrated, and (3) shows substantial potential for industry-wide application.

Provisions in the 1977 Clean Air Act Amendments authorize four-year waivers of the nitrogen oxides standard for automobile manufacturers proposing to incorporate innovative emissions control. 42 U.S.C. § 7421(b)(6) (Supp. III 1979). The provisions cast doubt on the seriousness of Congress' commitment to encourage basic process changes. Executives of the Ford Motor Co. made a seemingly persuasive presentation to a House Subcommittee, claiming that the industry would need a ten-year lead time and write-off period for capital investments to achieve any major process change. *Clean Air Act Hearings, supra* note 146, at 630 (letter dated March 21, 1977 from D.A. Jensen, Ford Motor Co. to Jeffrey Schwartz, Subcomm. on Health and Environment). The House proposal to allow for a ten-year extension was rejected by the Conference Committee in favor of a four-year period that is apparently too short to yield any significant results.

162. *See* note 9 *supra*.

163. *See* Tripp, *Tension and Conflicts in Federal Pollution Control and Water Resource Policy*, 14 HARV. J. ON LEGIS. 225 (1977).

164. S. REP. NO. 414, 92nd Cong., 2d Sess. 6, *reprinted in* [1972] U.S. CODE CONG. & AD. NEWS 3676.

165. The amendments seek to assure municipalities that alternative technologies will not carry with them the financial risk of failure. Full federal funding is guaranteed for modifications if an alternative system does not function up to standards. 33 U.S.C. § 1282(a)(3) (Supp. III 1979). The amendments contain three other provisions aimed at encouraging innovation in the construction grants program. First, rural states are required to spend 4% of their federal funds for alternative or innovative systems. 33 U.S.C. § 1285(h) (Supp. III 1979). Second, federal support for innovative projects undertaken in any state is now 85% instead of the standard 75%. 33 U.S.C.

sions have not stimulated much development of fundamentally new approaches, although they have promoted more consideration of existing alternatives to conventional sewer/outfall treatment technologies.[166]

c. *Redefining the Problem*

Programs that attack regulatory problems in broader terms than a "technological fix" have not been favored by Congress. For example, land use planning, including review of indirect sources such as highways, shopping centers, sports complexes, and parking structures, and promotion of public transit could help reduce vehicular air pollution. Measures to deal with nonpoint sources are a key element in effective water pollution control. Integrated pest management (IPM) technology promises more effective pest management with fewer environmental and health hazards. Congress, however, has limited agency authority to implement these institutional innovations. Authority to review indirect sources has been severely limited by amendments to the Clean Air Act.[167] The role for the federal government in controlling nonpoint sources such as agricultural run off has been limited to providing grants to study the problem.[168] A clause in the Federal Insecticide, Fungicide, and Rodenticide Act[169] that might have encouraged the development of alternative methods of pest control in lieu of chemicals was killed in committee.[170] These actions reflect, in varying degrees, the political power of those who would be adversely affected by the use of alternative approaches, the fear of disrupting established patterns of consumption and production, and congressional reluctance to trespass on matters traditionally reserved to the states.

d. *Trade-offs and Other Economic Incentives*

The trade-off policy, originally an administrative innovation by EPA to cope with the problem of new plant location in nonattainment

§ 1282(a)(2) (Supp. III 1979). Finally, construction grants made after September, 1978 will be conditioned upon the local agency's taking a "hard look" at alternatives. The approach, which is not unlike that for environmental impact statements, requires applicants to examine alternatives, including innovative technology, before obtaining federal funding. 33 U.S.C. § 1281(g)(5) (Supp. III 1979).

166. Telephone interview with James Loundsbury, Office of Analysis and Evaluation, Office of Water Planning Standards, U.S. Environmental Protection Agency (May, 1980).

167. Clean Air Act § 110(a)(5)(A), 42 U.S.C. § 7410(a)(5)(A) (Supp. III 1979).

168. Clean Water Act § 208, 33 U.S.C. § 1288(b)(2)(F)-(J) (1976).

169. *See* note 9 *supra*.

170. The so-called "doctrine of essentiality" would have allowed the Administrator to deny registration of new pesticides that were not deemed "essential." This tactic could have opened the way to an explicit comparative assessment of alternative control technologies. The Commerce Committee, however, refused to adopt this approach. The Act provides that "the Administrator shall not make lack of essentiality a criterion for denying registration of any pesticide." 7 U.S.C. § 1369(c)(5) (Supp. III 1979).

areas, was incorporated into the nonattainment provisions of the 1977 Clean Air Act Amendments.[171] The policy allows firms to locate plants in nonattainment areas, provided that they arrange for offsetting reductions by existing sources of pollutants and satisfy certain other requirements. There is no evidence that Congress' endorsement of the trade-off approach was informed by social innovation considerations. Nonetheless, by creating the possibility of a market in pollution rights, these provisions can provide a positive economic incentive for firms to develop innovative methods to reduce emissions.[172] If an existing firm can effectively "sell" emission reductions, it will have an economic incentive to develop innovative control methods beyond those that regulatory agencies can prove to be "available" and enforce through command-and-control regulation. Providing such incentives was an explicit consideration in EPA's adoption of the trade-off scheme,[173] and its subsequent promotion of the "bubble" policy.[174] The bubble policy, which allows intraplant pollution trade-offs, functions as an implicit trade-off market. In some instances both the trade-off and bubble policies have stimulated innovative control approaches that have substantially reduced compliance costs,[175] although both policies are too new to permit a full assessment.

While not specifically designed to promote innovative approaches for reducing pollutant discharges, user fees imposed upon industrial dischargers to municipal waste treatment systems have had such an effect in many cases, stimulating process changes, recycling, and other steps that reduce loadings and, consequently, fees paid.[176] This experience suggests that use of fees and taxes could promote social innovation in the field of industrial air and water pollution control.[177]

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171. *See* R. STEWART & J. KRIER, *supra* note 6, at 593-95.

172. *See* W. DRAYTON, *supra* note 130.

173. *See* Memorandum from Roger Strelow to EPA Administrator Russell Train, New Source Review Policy in Non-Attainment Areas (April 6, 1976) (on file with the author).

174. *See* W. DRAYTON, *supra* note 130.

175. *See id.*

176. *See* F. ANDERSON, A. KNEESE, R. REED, S. TAYLOR & R. STEVENSON, ENVIRONMENTAL IMPROVEMENT THROUGH ECONOMIC INCENTIVES 65 (1977) [hereinafter cited as F. ANDERSON]. *See generally* A. KNEESE, R. AYRES & R. D'ARGE, ECONOMICS AND THE ENVIRONMENT (1977) [hereinafter cited as A. KNEESE].

177. The implementing regulations for the heavy duty motor vehicle provisions in the 1977 Clean Air Act Amendments have recently been promulgated. *See* 40 C.F.R. §§ 86.1001 to .1014 (1980). They attempt to deal comprehensively with most issues in one comprehensive regulation package. The regulations encourage adoption of more durable control technologies through a more realistic definition of "useful life," and they implement the principle of structuring regulatory requirements in iterative three-year cycles with explicit consideration of fuel economy. However, they fail to exploit the full potential of nonperformance fees as a spur to state-of-the-art control technology. Originully, EPA proposed to set standards on the basis of its estimate of "available" technology and not to provide for any system of noncompliance penalties on the assumption that all manufacturers could meet the standards. In response to manufacturers' doubts

C. *Summary: The Significance and Role of Social Innovation in Regulatory Programs*

While the regulatory strategies employed by Congress have secured improvements in social performance, some of them substantial, there is reason to doubt that these strategies can, at acceptable cost, improve or maintain environmental quality over the long run in the face of continued economic growth. The diffusion of existing control methods under technological transformation strategies may be approaching saturation, and a substantially more restrictive culling policy would probably involve high costs. Invention of new control methods and environmentally superior products and processes now appears necessary to improve or even just to maintain environmental quality given continued industrial growth.

Strategies that rely on banning products that regulators can demonstrate to be unreasonably hazardous or that require firms to install control technologies that regulators can show to be reasonably "available" are unlikely to provide sufficient "demand" for the social innovation that will be required to achieve these objectives. Moreover, the disproportionate burdens imposed by the current system on new products and processes slows market innovation and associated turnover in the capital stock on which social innovation depends. Finally, as illustrated by the history of automotive air pollution control, the erratic "moving target" character of regulatory demand for innovation, readjusted in response to new information, unexpected compliance problems, or swings in political mood, chills social innovation by making the regulatory "demand" for such innovation highly uncertain.

These are persuasive grounds for concluding that existing strategies must be supplemented or replaced by more positive incentives for social innovation. The previous discussion suggests the following considerations should guide the design and implementation of regulatory programs to promote market and social innovation:

(1) The regulatory "stick" is often a clumsy or ineffective tool for advancing the state of the art in social performance, which indicates the desirability of providing positive rewards ("carrots") for social innovation.

(2) Fees and transferable pollution permits provide carrots in the form of financial rewards for social innovators.

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concerning the feasibility of meeting the standards, EPA has agreed to provide noncompliance penalties for vehicles whose emissions exceed the standard, but do not violate a specified upper limit. However, it has continued to insist that the requisite technology to meet the standards is "available." EPA apparently intends to structure the fee schedule on the basis of marginal compliance costs in order to foreclose any competitive advantage from noncompliance. This approach differs conceptually and functionally from a system of emission fees designed to advance the state of the art.

(3) Encouraging the development of external supplies of social innovation by providing a market for such suppliers' products is another desirable form of carrot.
(4) In many cases, government research and development support, fiscal incentives, and other forms of active reward or subsidy may also be needed to foster social innovation.
(5) Intrusive government controls over firm investment may be necessary to secure basic product and process changes on the part of technologically mature, oligopolistic industries, such as the domestic automobile industry.
(6) The efficacy of the regulatory stick in promoting social innovation might be improved by expanding the research and development capabilities of regulatory agencies.
(7) Measures to reduce uncertainty and delay regarding regulatory requirements would help encourage social innovation.

IV
ALTERNATIVE TOOLS AND DECISIONAL PROCESSES

This Article identifies the need for modified or alternative regulatory tools and decisional procedures that would ameliorate the adverse impact of the present regulatory system on market innovation and provide more effective incentives for social innovation. Because regulators have not paid adequate attention to innovation in the past, it is not possible to determine how much the current system affects market or social innovation or the extent to which performance might be improved by different kinds of regulatory tools or other incentives. Institutional inertia is an obstacle to basic changes in the current system. Although the Reagan administration is concerned about the impact of regulation on productivity, it seems more intent on simply cutting back the existing regulatory system and reducing stringency than on developing new approaches.

Part IV of this Article outlines general criteria for assessing alternatives to improve market innovation. Ideally, alternatives should lower the compliance and decisional costs incurred by regulated firms; minimize technical constraints and maximize flexibility for achieving compliance; reduce uncertainty regarding the regulatory requirements applicable to new products and processes; reduce delay in determining and applying such requirements; and eliminate or reduce special regulatory burdens on new products or processes and on firms that can better "afford" such burdens.

Part IV also identifies general criteria for assessing the potential of alternatives to support social innovation. Proposals should minimize technical constraints on how firms may achieve compliance or respond to incentives; provide positive incentives for innovations by regulated

firms that advance the state of the art in social performance; and encourage the development of markets for external supply of innovative socially superior products or processes.

Despite the complementary character of market and social innovation, these two sets of criteria often conflict when applied to particular regulatory problems. Adoption of a given alternative may promote market innovation relative to the existing system but harm social innovation or vice versa.[178] Moreover, alternative tools can only be usefully assessed in the context of a particular social program; the performance characteristics of a given approach may be quite different in situations as diverse as stationary-source sulphur dioxide pollution, automobile fuel economy, and pesticide toxicity.

Given this complexity, exhaustive analysis, even at a conceptual level, of alternatives is not possible within the confines of this Article. Accordingly, the discussion that follows will explore four categories of alternative regulatory tools: modifying the current command-and-control system; subsidizing social innovation; promoting the external supply of social innovation; and adopting market-based incentives, such as pollution taxes or transferable pollution rights. The discussion will then examine five categories of procedural and institutional changes: modification of existing procedures, informal negotiation in standard setting, increased use of technical advisory committees, decentralized regulation, and centralized sectoral planning. One other possible change—redefinition of the problem—will be explored in the next section.

Part V will consider links between changes in regulatory tools and institutional changes, discuss issues of centralization and decentralization, and offer an agenda of priorities for modification of the current system.

A. Alternative Tools for Achieving Social Goals

1. Modify Command-and-Control Regulation

Most proposed modifications to the present command-and-control regulatory system have focused on reducing compliance outlays. This

178. For example, promotion of external supply of social innovation through procurement contracts could well increase delay and uncertainty related to regulation and thereby inhibit market innovation. In some contexts, however, the attributes of tools and decisional processes, such as reduced constraints or delay, that promote social innovation will also promote market innovation, although those attributes might compromise some goals of the current regulatory system. For example, a system of pre-set emission fees with built-in constraints against revision of the fees and a provision for recycling fee revenues on a basis other than proportional emissions would rank quite favorably under the criteria specified above. However, it might rank quite unfavorably with respect to many objectives of the present system—most notably the desire for assured control over regulated firms' behavior.

subsection considers a wider variety of modifications and assesses their impact on innovation. In addition to reducing compliance outlays, the most promising alternatives are reducing the disproportionate regulatory burdens imposed on new processes and products; introducing more flexibility into regulatory requirements and compliance strategies; and increasing the use of standards in chemicals screening. However, as long as the basic framework of command-and-control regulation is preserved and social goals are not relaxed, the prospects for improving regulatory impacts on social or market innovation appear limited.

a. More Equal Treatment of New and Old Plants and Products

i. Industrial sources. Imposing disproportionately greater burdens on new plants or on existing plants or industries better able to "afford" such burdens discourages market innovation.[179] However, the context of a command-and-control regulatory system severely limits the range of possible remedies. Regulatory controls that result in widespread plant closings have proven socially unacceptable in the absence of compelling evidence that such disruptions are necessary to prevent serious damage to human health or to the environment. The constraint would be even more limiting if control burdens on existing firms were allocated on a basis other than "affordability," because the threat of plant closings would be increased. Accordingly, if new-source controls were equated with existing-source controls, the overall stringency of controls would be reduced to avoid disruptions and "control insurance" would be sacrificed.[180] In addition, more stringent controls on new sources interpose a brake on the incentive of firms to relocate from "dirty" to "clean" areas—a form of disruption that Congress has been conspicuously anxious to avoid. New-source/old-source parity would remove this brake.

A more modest step would be to encourage or require regulators to focus attention on the relative stringency of old-source/new-source requirements to ensure that the balance did not unduly discourage new-source investment and turnover of the capital stock. EPA at present does not undertake any such analysis. However, this proposal has several difficulties. Under the present regulatory structure, new sources and old sources are subject to different statutory requirements and procedures.[181] In addition, the factors involved in making such an analysis

179. *See* note 98 *supra*.

180. *See* text accompanying notes 39-45 *supra*. In addition, more stringent controls on new sources may tend to promote a least-cost allocation of abatement burdens, because new sources can generally achieve a given level of control more cheaply than existing sources which must be retrofitted. Parity, to the extent that it does not simply lower aggregate performance, can result in higher abatement costs and adversely affect innovation.

181. For example, under the Clean Air Act, old sources and motor vehicles in use are subject

are extraordinarily elusive and difficult to document. Reducing the stringency of requirements on new sources would prevent administrators from requiring new plants to install technologies that can be shown to be "available." Because the potential gains would be speculative, command-and-control regulators would be hard pressed to justify their actions. Allocations of regulatory burdens on a basis other than "affordability" would raise similar problems.

ii. Chemicals. Ensuring that new chemicals are not subject to more stringent or burdensome controls than existing chemicals could promote both social and market innovation. The Federal Insecticide, Fungicide, and Rodenticide Act[182] now affirms this goal in principle, while the Toxic Substances Control Act[183] seems to reject it.[184] Whether the existing system in practice imposes heavier burdens on new products is not clear.[185] The development of standardized categories of chemicals[186] and of corresponding regulatory requirements, however, could reduce disparities in the effective regulatory burden applied to new and existing chemicals.

b. Restructure Regulatory Requirements and Compliance Strategies

i. Automobiles: longer lead times and greater flexibility. A technology-based "moving target" set of standards applicable only to new cars adversely affects both social and market innovation by creating substantial uncertainty regarding regulatory requirements, by discouraging investment in major innovations whose compatability with future regulations cannot be ascertained, and by failing to provide positive

to state implementation plan requirements designed to achieve federal ambient standards; new sources are subject to federal new-source performance standards, and to lowest-achievable-emission-rate or best-available-technology emission limitations. New motor vehicles are also subject to a separate system of federal limitations. Although these new and old sources and products emit the same pollutant, they are subject to different regulatory requirements. Even without this impediment, it would be analytically and conceptually difficult to maintain an ideal of parity in regulatory burdens in a dynamic regulatory system. *See* B. ACKERMAN, S. ACKERMAN, J. SAWYER & D. HENDERSON, THE UNCERTAIN SEARCH FOR ENVIRONMENTAL QUALITY 231-43 (1974) [hereinafter cited as ACKERMAN].

182. *See* note 9 *supra*.

183. *Id.*

184. *Compare* 15 U.S.C. § 2604(a)(1) (1976) (requiring new approval for every new chemical or chemical use) *with* 7 U.S.C. § 136a(c)(7) (Supp. III 1979) (permitting conditional or amended registration of new pesticide if pesticide and its proposed use are substantially similar to any currently registered pesticide and use would not differ in any way that would significantly increase risk of adverse affects on environment).

185. Other things being equal, inertia and legal complications make it more difficult for an agency to remove an existing chemical from the market than to block the entrance of a new one. On the other hand, existing chemicals have been put to the test of actual use. They are more likely to have generated evidence of adverse effects and may therefore be more vulnerable to agency action.

186. *See* text accompanying note 196 *infra*.

incentives for superior social performance. These effects may be aggravated by the oligopolistic and technologically "mature" character of the industry.

There are two basic alternatives for dealing with these problems while continuing to rely upon a command-and-control regulation strategy. One is for Congress or the agency to set ambitious performance requirements and allow the manufacturers a substantial lead time—perhaps seven to ten years—to achieve compliance without "front loading" interim requirements that can turn "technology forcing" into "technology freezing." This approach might lessen adverse effects on market innovation, but it has other problems. The sanctions threatened for noncompliance are likely to be either too mild to stimulate sustained innovation efforts or too draconian to be credible, thereby removing any assurance that the increased flexibility afforded manufacturers will eventually result in greater social innovation. On the other hand, abandoning front loading creates a sizeable danger of foregoing social innovation that could have been achieved under an incremental approach.

A second alternative for handling the moving target problem is to give the responsible administrative agency much greater flexibility in framing performance requirements, including the possibility of establishing different time-phased requirements for different manufacturers and permitting performance trade-offs among various pollutants. This flexibility could be used to negotiate "packages" of requirements with each manufacturer to accommodate and encourage more innovative solutions to improved social performance while reducing regulatory uncertainty. The flexible approach raises three major objections: the noncredible nature of sanctions for compliance failure, distrust of administrative discretion that pervades the current system, and the consequent fear that social performance under such an approach would not improve and would probably worsen.[187]

As a third alternative, technical constraints could be eased to alleviate their adverse impact on both social and market innovation. For example, pollution control performance could be determined on an aggregate basis that permits averaging of performance by different vehicles or averaging of different pollutants, within a range set for each pollutant. Automobile emission requirements could be established according to a fleet-wide average. Apart from possible problems posed

187. More modest adjustments to the present system may be considered, although their benefits in terms of innovation are likely also to be modest. Uncertainty can be reduced by establishing regulatory requirements farther in advance. Longer lead times also give manufacturers more flexibility in the choice of control options. Congress to some extent recognized the desirability of longer lead times in the 1977 amendments to the motor vehicle provisions of the Clean Air Act, §§ 202(b)(6)(A), (B), 42 U.S.C. § 7521(b)(6) (Supp. III 1979), and in the fuel economy schedule.

by geographic variations in the fleet mix, this approach, which would put emission requirements on the same footing as fuel economy, appears highly commendable from the perspective both of market and social innovation.[188]

A related alternative recognized in the 1977 Clean Air Act Amendments[189] establishes more rigorous emissions, safety, and fuel economy requirements for a designated percentage of each manufacturer's fleet. Requiring each vehicle in a manufacturer's annual production to meet the same standard inevitably brakes the development of new control technologies. Requiring higher-than-average performance by a portion of new cars could encourage the development of more innovative technologies which, if successful, could then be extended to the entire fleet through the "trickle down" process of diffusion familiar to the industry.[190]

ii. Industrial sources: longer lead times and greater flexibility. Although industrial pollution regulations are much more complicated than automobile regulations,[191] they are likewise subject to the problems created by the "moving target" character of technical constraints imposed by regulation. Incremental adjustment of regulatory

188. The EPA's recent decision with respect to light duty motor vehicle diesels may represent a de facto move in this direction. 44 Fed. Reg. 6650 (1979). There may, however, be an equity objection to such an approach. Arguably, larger, more powerful cars should not be allowed to pollute more. Such equity concerns did not prevent adoption of a fleet-wide average approach for fuel economy, but in that case, cars with lower fuel economy incur a market penalty in the form of higher fuel costs, and an additional regulatory penalty is imposed on extreme gas guzzlers. The fuel economy example suggests that equity concerns might be met in the context of a fleet-weighted-average approach to emissions performance combined with a fee or tax on higher than average emissions performance.

189. Clean Air Act § 202(b)(7), 42 U.S.C. § 7521(b)(7) (Supp. III 1979), requires manufacturers to "build and on a regular basis, demonstrate" light duty motor vehicles that meet the research objective for nitrogen oxides control.

190. The prospect of subsequent regulations requiring that innovations be applied to a manufacturer's entire fleet may chill the development of such innovations. This effect might be alleviated by (1) defining required performance in terms of fleet-wide averages, allowing manufacturers to retain flexibility and diversity in control/marketing strategies; (2) using "carrots" in the form of research and development subsidies designed to encourage innovative control technologies for "thin" markets, *see* Abernathy & Chakravathy, *The Federal Initiative in Industrial Innovation: The Automobile Case*, 20 SLOAN MANAGEMENT REV. 5 (1979); and (3) instituting a period of mandatory delay in follow-up in "trickle down" regulatory requirements. The definition of control technologies' required "useful life," presently established at only 50,000 miles in the case of light duty motor vehicles, could also be expanded to encourage the development of more durable control technologies.

191. Industrial pollution regulation is complicated by three factors: the variety of regulated processes, the need to regulate existing as well as new sources, and ambient performance standards that override technology-based control requirements. The regulatory system includes more stringent, incrementally-ratcheted control requirements for new sources than for existing sources; subcategorization of performance requirements, with a tendency towards individual screening, particularly of new sources; and the possibility of outright prohibition of new sources in some locations because of air quality limitations on additional emissions.

requirements for stationary sources creates uncertainties that chill investment in new plants and that may discourage development of basic process changes that could yield environmentally superior performance. Two alternatives discussed in connection with automobile regulation—setting ambitious requirements with long lead times and negotiated "packages"—could apply here. A system in which permits were issued on a five- or seven-year cycle, with a prohibition against tightening requirements in the interim save in case of demonstrated emergency, could alleviate uncertainty and promote orderly administration with little or no sacrifice of stringency.[192] By monitoring emissions over longer times, standards could be set with larger averaging periods, thereby increasing source control flexibility. It would also, as developed below, facilitate greater use of emission fees and tradeoffs.[193] Existing monitoring technology is adequate for increased emphasis on direct measurement of emissions but is underutilized, partly because of regulators' failure to use monitoring data effectively. Potential advances in monitoring technologies over the near term could greatly facilitate emission-based control systems, provided adequate regulatory demand for such technology were provided.

For industrial sources, the constraints imposed by standards could be ameliorated by moving towards a screening approach and tailoring controls to the particular circumstances of each source. This step would, however, increase decisional costs and delays and could offend equity principles of equal treatment of competing sources and regions.[194] More liberal use of innovation waivers could be attempted,

192. It would, however, sacrifice the opportunity to achieve interim improvements in environmental quality.

193. *See* text accompanying notes 217-46 *infra*. Improved monitoring capability is also needed to ensure proper implementation of existing command-and-control standards. Capital intensive end-of-pipe control technologies must not only be installed; they must be properly operated and maintained. An EPA study of sources deemed in compliance with regulatory requirements because they had installed the necessary control technology found that emissions substantially exceeded permitted levels, largely because of operation and maintenance deficiencies. *See Drayton*, note 131 *supra*. Operating and maintenance costs of major abatement equipment often run from 25% to 60% of annual capital costs. Given the lack of market incentives for incurring such costs and given limited enforcement capabilities, more reliable monitoring and recordkeeping capacities and enforcement are essential under any regulatory system. The monitoring capability need not consist of end-of-pipe or top-of-stack monitors. It may be possible to monitor the operation of control technologies and internal processes as a surrogate for actual emissions performance. Crude sampling measures, rules of thumb determining emissions on the basis of plant and process characteristics, and increased sanctions for detected violations are other options.

194. Improving the mix between screening and standards involves trade-offs between the uncertainties and decisional costs related to screening and the technical constraints and inflexibility of standards. The optimal mix will vary depending on the precise context. The difficulties of achieving substantial improvements over current practice are substantial. For example, best-available-technology and best-practicable-technology water pollution effluent standards could be modified through screening to reduce control requirements where acceptable ambient water quali-

but the prospects for significant gains are not bright.[195] Pursuit of these alternatives to promote market and social innovation is worthwhile, however, so long as the present command-and-control approach is maintained.

c. *Standards Approach to Chemical Regulation*

The regulation of chemicals involves, almost inevitably, a "culling" approach that bans certain chemicals or precludes use of chemicals posing risks deemed unacceptable. The market presumably will generate substitute chemicals with risks deemed acceptable. This approach leaves few options for promoting innovation.

As noted above, the degree of effective stringency in regulatory requirements imposed on existing and new chemicals can be equalized. The general degree of risk judged acceptable could also be increased. This strategy would promote market innovation by loosening technical constraints and compliance (testing) outlays and decisional costs, but would retard social innovation and undercut social goals.

A more promising alternative is targeting more intensive or rigorous regulatory requirements at those chemicals or uses that threaten greater risks, because they are more hazardous, involve more risks of exposure to humans, or are produced in greater volume. Less restrictive or burdensome requirements could be imposed where the risks are correspondingly less or to encourage new approaches to pest control,

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ty could be achieved with lesser control. This step would reduce compliance outlays, but there are offsetting objections: excessive administrative costs, long term upward pressure on ambient standards, and competitive dislocations. The first two objections could be minimized by putting the burden of securing a screening-based modification of standards on the source and limiting its availability to situations where environmental risks are minimal. The use of deep ocean outfalls for municipal waste, as authorized in the 1977 amendments to the Federal Water Pollution Control Act, is an example of this approach. Clean Water Act of 1977 § 44, 33 U.S.C. §§ 1311, 1342 (Supp. III 1979).

Another approach would, by analogy to fleet-wide averaging for auto fuel economy, permit firms with several plants to average performance for best-available-technology/best-practicable-technology standards. The uncertainties created by this strategy and the diffusion of research and development investment opportunities might undermine incentives to develop less costly or better performing control technologies.

195. This involves the waiver of otherwise applicable regulatory requirements for innovative technologies that promise improved social performance over the longer term. This option could be employed for all the regulatory schemes under examination. While attractive in principle, this approach, as experience with waiver provisions in the 1977 amendments to the Clean Air Act and the Federal Water Pollution Control Act suggests, is likely, in practice, to provide little incentive for social innovation. Given the basic premises of the command-and-control regulatory system, such waivers are bound to be procedurally and substantively hedged. The decisional costs for obtaining a waiver are likely to be high. Regulators will be reluctant to forego demonstrable improvements in social performance for the speculative promise of even greater benefits in the future. Most importantly, the regulatory system itself provides little or no positive reward for successful social innovations. Uuless such innovations also bring powerful market rewards, the waiver process is unlikely to be very productive.

such as biorationals. Alternatively, variations could be introduced along a continuum between a pure screening approach, in which risk evaluation and associated testing are "hand tailored" to the individual chemical and its particular characteristics and uses, and a standards approach, in which risk evaluation would be a function of several factors such as performance on a standardized test battery, chemical category, production volume, and the nature and manner of human and environmental exposure given the chemical's proposed use.[196]

These options could promote market innovation by adjusting the rigor and incisiveness of regulatory requirements to the probable magnitude of risk. This approach would involve less demanding requirements for small-volume chemicals manufactured by small firms that are most burdened by regulatory requirements and which may have an important role to play in innovation. However, substantial implementation difficulties are likely. A standards approach could involve additional constraints and compliance outlays, particularly if regulators took a risk-adverse approach in framing standards by routinely including elaborate testing requirements. Little positive impact on social innovation may be expected from the targeting approach except where small-volume pesticides or chemicals may be socially innovative or fill "orphan" needs.

d. Reduce Compliance Outlays

To the extent that innovation is adversely affected by resource diversion, innovation would be promoted by steps to reduce compliance outlays. Such steps could include more cost-effective allocation of control burdens among regulated processes or products and measures to adjust control burdens in relation to benefits.[197] Efforts are already un-

196. *See* Slesin & Sandler, *Categorization of Chemicals Under the Toxic Substances Control Act*, 7 ECOLOGY L. Q. 359 (1978). The effort to categorize chemicals for these purposes by chemical family or structure is limited by the fact that small variations in structure can significantly change activity and social performance.

197. Agencies implementing the current regulatory system implicitly or explicitly consider compliance outlays as part of the assessment of "available" technology in framing and applying regulatory requirements. More systematic pursuit of cost-effective allocation would seek to equalize the marginal costs of abatement burdens among various industries or sources. For Clean Air Act ambient standards, this approach would strive to equalize abatement costs among all sources in a given air basin. However, the current statutory fragmentation of regulatory responsibilities and requirements renders this impractical. *See* note 181 *supra*.

For a single set of technology-based standards (new-source performance standards, best-available-technology, best-practicable-technology), cost effectiveness would require the equalization of marginal abatement costs among industry categories and subcategories. The data and analyses required to determine relative cost effectiveness are complex and riddled with challengeable assumptions. If an industry could object to a proposed standard because it imposed marginal control costs higher than those imposed on other industries, the proliferation of issues involved in setting standards through formal proceedings could lead to a breakdown of the system. *See* Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375 (D.C. Cir. 1973), *cert. denied*, 417 U.S. 921

derway to meet these goals. Agencies are promoting more cost-effective allocation of regulatory burdens,[198] and President Reagan has directed federal regulatory agencies to employ, to the extent permitted by law, cost-benefit analysis in framing regulations with major economic impacts.[199]

By reducing compliance outlays these efforts can assist market innovation within limits. Because of the severe difficulties in quantifying the invisible opportunity costs associated with regulatory constraints, uncertainty, and delay, both cost-benefit and cost-effectiveness analyses are likely to miss or discount important kinds of innovation burdens.[200] Analytical astigmatism may simply lead regulators to shift forms of regulation from those, such as standards, whose compliance burdens are more easily measured,[201] to others, such as screening, that involve a greater proportion of invisible opportunity costs.[202]

The effectiveness of cost-benefit and cost-effectiveness analyses also is undermined by data limitations, divided regulatory responsibilities, and statutory constraints. Their use will complicate and extend the

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(1974). If industry could not raise the cost-effectiveness issue, agencies might have little incentive to pursue it.

Steps could be taken to require a harder look at the benefits of alternative regulatory measures and to tailor burdens to benefits. Some efforts are being made in this direction, such as the relaxation of the ambient standard for oxidant, waiver of secondary treatment of conventional pollutant discharges from deep ocean outfalls, and waiver of thermal pollution control requirements for ocean discharges. There are two obstacles to extending a cost-effectiveness approach while stopping short of overall relaxation of social goals. First, assessing priorities is made particularly difficult by large uncertainties, particularly in quantifying benefits; *see* A. FREEMAN, *supra* note 4, at 248-50. However, compliance cost assessment is also hazardous. *See* Comparisons of Estimated and Actual Pollution Control Capital Expenditures for Selected Industries, *prepared for* Office of Planning & Evaluation, EPA, by Putnam, Hayes & Bartlett, Inc. (June, 1980) [hereinafter cited as Comparisons]. Second, adjusting burdens to benefits often requires adoption of nonuniform measures in direct opposition to the extremely powerful political and bureaucratic incentives for adoption of uniform standards.

Formal benefit-cost analysis would, in theory, seek to adjust each regulatory requirement to maximize the excess of benefits over costs. But even a less modest goal—such as achievement of a given ratio of benefits over costs—would be largely unattainable because of limitations of data, the complexity and fragmentation of regulatory programs and provisions, and the vast amounts of time and administrative resources needed to perform and implement the necessary analysis. Progress must largely occur through informal administrative practices arising from general political commitments to reduce regulatory burdens. *See* ACKERMAN, *supra* note 181, at 230-35.

198. *See* note 197 *supra*. For discussion of some of the opportunities for greater cost effectiveness under existing regulatory structures, see Del Duca, *The Clean Air Act: A Realistic Assessment of Cost-Effectiveness*, 5 HARV. ENVT'L L. REV. 184 (1981).

199. Exec. Order No. 12291, 46 Fed. Reg. 13193 (1981).

200. Substantial problems exist in predicting the compliance outlays that would be required by particular regulations. *See* note 197 *supra*.

201. Similar problems are presented by regulatory budget proposals. These problems will persist despite the effort, reflected in President Reagan's Executive Order, *supra* note 199, to include innovation impacts in the analysis.

202. For a discussion of these and other dynamic problems in maintaining a least-cost allocation of abatement burdens, see ACKERMAN, *supra* note 181, at 223-59.

decisional process. Cost-effective allocation of regulatory burdens may generate perverse incentives by imposing greater burdens on those firms that have been most successful in improving social performance at lower cost.[203] The measurement of benefits under cost-benefit analysis presents other controversial and difficult problems. There is also justified concern that industry-sponsored use of these techniques would result in large and unjustified cutbacks in social goals.

So long as a command-and-control system is maintained, efforts to allocate burdens efficiently will be a necessary but limited antidote to the adverse dynamic tendencies inherent in that system. These tendencies arise from reliance on administrative determination of conduct and the accompanying need for protracted, relatively formal proceedings to change those determinations.

2. Subsidies

Another method of promoting social innovation within the basic context of command-and-control regulation is government subsidy. It can take the form of capital or operating grants, tax deductions or credits, payments based on performance, or assumption by the government of research and development responsibilities. While subsidies would reduce compliance costs, the market innovation benefits of such a step are rather speculative. Other alternatives for promoting market innovation, such as investment tax credits or quick writeoffs, seem to promise a higher benefit/outlay ratio. Accordingly, the justifications for government subsidy of improved social performance must be found in social innovation.

The issue is a large one and includes questions concerning the allocation of the Department of Energy's research and development budget among alternative energy sources, proposals for "crash" research and development programs for fundamental redesign of the automobile, and government support of research and development by small chemical companies. Little systematic study of the more general issues posed by government subsidy of social innovation through regulation has been carried out. Only a few general points can be addressed here.

Subsidies might be used to induce firms to install already available control technology. However, considerations of equity and efficiency dictate that the costs of modifying behavior judged socially unacceptable should ordinarily be borne, not by taxpayers, but by firms and by consumers of the firms' products. The limitation of municipal waste treatment grants to capital costs and the limitation of tax breaks to

203. *See generally* Rodgers, *Benefits, Costs, and Risks: Oversight of Health and Environmental Decisionmaking*, 4 HARV. ENVT'L L. REV. 191 (1980).

"add-on" pollution control devices indicates that government subsidies are often designed to confer benefits on politically powerful groups or to protect the public fisc rather than to meet equity or efficiency criteria. But these limitations discourage social innovation and increase compliance costs. A system of "sticks," such as command-and-control regulation or fees would seem far preferable as incentives for diffusion of available control technology.

This conclusion is subject, however, to an important caveat. Increased turnover of capital stock is vital to improved social performance. Existing regulatory systems discourage this turnover by imposing substantially more stringent controls on new sources. One method to counteract this disincentive and to encourage greater turnover while providing reasonable protection to the fisc would be to give an immediate tax writeoff in an amount equal to the costs of compliance for the plant replaced.[204]

Using subsidies to promote invention poses different questions. As previously developed, the incentives provided by a system of regulatory "sticks" for the invention, as opposed to diffusion, of socially superior products and processes are often weak.[205] Moreover, any incentives would be eroded by the ability of competitors to appropriate an invention without compensating the inventor, whose work is only partly protected by the patent system.

"Sticks" may also fail to stimulate enough invention from external suppliers because of uncertainty concerning future regulatory requirements and the need for cooperation by regulated firms. An assured subsidy for invention may be needed. Determining when to subsidize and the proper amount and form of subsidy raises difficult questions.[206]

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204. Existing plants sufficiently modified to be subject to new performance standards also could benefit from a similar write-off. Logically, the write-off should be set equal to the excess of the control costs for new replacement plants over those for existing plants, but that would be a much more difficult figure to establish administratively because of the interplay between control measures and process changes. Entirely new sources should receive a writeoff equal to the average cost of controlling existing plants.

205. *See* text accompanying notes 119-152 *supra. But see* note 207 *infra.*

206. Rather than relying on more-or-less indirect incentives, such as regulatory performance standards or subsidies, the government might simply order firms to undertake investments in specific social innovations. The objections to such a course are substantial. It is unlikely that the government can better decide than firms themselves what types of innovations are likely to meet social performance objectives, consistent with the institutional, technological, and marketing constraints that firms face. Firms are not only likely to have superior information and competence, but the multiplicity of potential solutions that may be adopted by various firms provides a better hedge against innovation uncertainties than centralized choice by the government. In addition, dictation of firms' social innovation by the government may create serions adverse effects on market innovation. Nevertheless, some firms are not responsive to other incentives for social innovation, because their technology is mature and because they are insulated from competitive pressures to undertake fundamental changes in their way of doing business, even though the social desirability of a particular innovation is obvious. Investment by electric utilities in cogeneration

In order to provide incentives for social innovation, the government might underwrite and guide investments in research and development by regulated firms, or undertake the research and development itself, or subsidize or otherwise encourage the development of an external supply. Government research efforts have succeeded in some cases in developing social innovations that were then diffused through regulatory requirements. However, these alternatives have important limitations. Political considerations inhibit large-scale appropriations. Centralized bureaucratic decisionmaking is a questionable strategy for identifying and pursuing the most promising technical opportunities; decentralized decisionmaking by firms affords a better hedge against the substantial uncertainties that characterize innovation choices. Tax incentives do not provide affirmative incentives for social innovation; if such incentives already exist, tax expenditures may be spent for research and development that would have occurred anyway. The ultimate objective is a tax and fiscal system that encourages turnover of capital stock in conjunction with other incentives to ensure that the new stock is socially superior.

3. Externalizing the Supply of Social Innovation

Another strategy for promoting social innovation within the context of command-and-control regulation would be to encourage the development of the pollution control supply industry. As previously noted, regulation often provides inadequate or negative incentives for investment by regulated firms in social inventions to achieve better social performance.[207] Suppliers of pollution control equipment do have market incentives to undertake social innovation and publicize positive results. However, suppliers' sales represent only a small proportion of current compliance expenditures, reflecting the existence of substantial

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and certain other alternative energy sources such as customer solar is an example. *See* Cal. Public Utilities Commission Decision 91109, at 33-34 (Dec. 19, 1979) (imposing penalties on an electric utility for failure to undertake sufficiently vigorous efforts to develop cogeneration projects).

207. *See* text accompanying notes 119-152 *supra*. However, ambient-based standards, including the system of prevention at significant deterioration increments, provide incentives for inventions that promote superior social performance not provided under a regulatory system of technology-based standards. Existing firms in areas that have not achieved ambient standards will be more strongly motivated to improve their performance, although shutdown constraints blunt the threat of sanctions for noncompliance with source performance requirements designed to insure attainment. Would-be new sources in areas with limited increments of unused clean air would face more powerful incentives to invest in innovation aimed at higher levels of control than afforded by the existing state of the art.

Also, firms have incentives to invest in innovations that reduce the cost of complying with existing standards. If these innovations also lower the costs of achieving greater levels of control, they may pave the way for improved social performance.

constraints on external supply.[208] Uncertainty created by the "moving target" character of regulatory requirements diminishes the assurance of a market for successful social innovation. For example, California, because of public opposition, rescinded requirements that car owners install retrofit pollution controls, stranding manufacturers who had invested heavily in developing retrofit devices.[209] Several airbag manufacturers have renounced the field because of continuing uncertainty over whether and when use of their products will be mandated.[210] In addition, vendors of control technology may lack the size or resources to develop innovative technologies on a commercial scale without close cooperation of the regulated industry; a recent study documented this problem for air pollution control of fossil-fired electric generating plants and nonferrous smelters.[211] Regulated industry is unlikely to provide such cooperation. Finally, a regulatory standards approach often aims at uniform "end of pipe" control methods, restricting the range of technical options that suppliers can profitably explore.[212]

Additional steps could be taken within a command-and-control framework to encourage supplier research and development. The government could purchase social innovations such as solar collectors for its own use and require their use by regulated firms once feasibility is established.[213] However, the scale of government purchases may be too small to provide the necessary incentives. Furthermore, if a supplier already provides the regulated industry with a substantial amount of conventional commodities, it may fear covert retaliation by the regulated industry for developing innovations. The government's use requirements on innovative products and processes may also fail to take account of competitive marketing and operating constraints and the exigencies of reliable-scale operation.

Alternatively, the government could commit itself to requiring the adoption of innovations meeting certain performance specifications.[214] A firm commitment would alleviate the serious uncertainty surrounding government decisions whether to impose, postpone, or cancel regu-

208. *See* T. Rothermel & C. Bentz, The Economic Effects of Environmental Regulation on the Pollution Control Industry (1978) (study for EPA).

209. *See* J. KRIER & E. URSIN, POLLUTION AND POLICY 240-47 (1977).

210. *See* R. LEONE, *supra* note 49, at 111-24.

211. *See* Note, *supra* note 77, at 1729 n.80.

212. However, by restricting the targets of opportunity, a standard might encourage greater research and development investment by supplier firms because of the greater probability of a high payoff. *See* R. Repetto, The Influence of Standards, Effluent Charges and Other Regulatory Approaches on Innovation in Abatement Technology (Sept. 3, 1980) (on file with *California Law Review*).

213. *See* Note, *supra* note 77, at 1729.

214. *See* Ginsberg, *supra* note 81, at 97-101. This strategy could be combined with a program of government purchases or subsidies to encourage internal as well as external supply.

latory requirements, but the "commitment-to-regulate" alternative has substantial unresolved problems. Regulatory agencies might not be able to make such commitments under the existing law. Drawing sufficiently precise performance specifications could be a problem. Another firm might develop a superior innovation or the qualifying innovation might cause previously undiscovered adverse side effects. The government would have to develop a policy on patents.[215] As noted above, in many situations external supply may depend on the close cooperation of regulated firms, which could weaken the potential of a commitment-to-regulate strategy. However, given the difficulties with other approaches to stimulating social innovation under a regulatory system, the commitment-to-regulate approach[216] has sufficient merit to justify further analysis of these problems. Its use might be particularly appropriate for technologies such as fluidized-bed coal combustion.

4. Market-Type Incentive Systems

Command-and-control regulation, if adequately enforced, assures specific changes in regulated firms' conduct, including the adoption of "available" technology, but it constrains incentives for social and market innovation. The opportunities to promote innovation within the context of command-and-control regulation are restricted, as the previous discussion indicates. Market-based tools designed to promote superior social performance are more likely to preserve or increase such incentives, but at a sacrifice of control assurance.

a. Emission or Noncompliance Fees or Taxes

The distinguishing features of command-and-control regulation are prescription of the precise conduct required of each person subject to regulation and enforcement of that prescription by penalties that do not allow inferior performance, provide no incentive for superior performance, and often do not adjust sanctions to the degree of noncompliance.

Under a system of emission or noncompliance fees or taxes, social performance is first reduced to some common unit of measure such as grams of emissions per mile or miles per gallon. A fee or tax is then levied proportionate to the degree that the measured performance of a product or process falls short of some designated level. Lower taxes or fees are assessed against products or processes offering superior per-

215. For a preliminary discussion of these issues, see *id.*

216. Students of the innovation process have found that "demand pull" is more important in stimulating innovation than "technology push." *See* Nelson & Winter, *In Search of a Useful Theory of Innovation*, 6 RESEARCH POL'Y 36-76 (1977). The commitment-to-regulate approach could provide a strong stimulus to social innovation by providing substantial demand for successful innovation.

formance; higher charges are assessed against those with inferior performance. The same tax or fee schedule applies to all products or processes in a given category. Each firm determines for itself the level of performance that it will achieve, based on a comparison of the additional costs it will incur in improving its performance versus the fees that it must pay if it fails to do. The government sets the fee level; the degree of performance achieved is a function of decentralized decisions by individual firms.

The need for an objective yardstick of social performance limits the potential application of a fee system. Environmental and safety risks associated with chemicals and with automotive design appear, at least on the current state of the art, too variable to make feasible a single quantitative measure of performance.[217] But in the field of pollution control the fee system holds promise for promoting both market and social innovation.

First, an emission fee system would promote a least-cost allocation of control burdens without the substantial administrative costs and disincentives[218] involved in attempting to achieve such an allocation under a regulatory approach. This result would occur because pollution sources would employ control measures in rank order of cost effectiveness. Sources that can abate more cheaply will eliminate the most pollutants. Firms faced with high pollution elimination costs will abate the least. Subject to important qualifications concerning the disposition of fee payments, to be discussed below, these allocations would reduce compliance outlays and therefore tend to promote market innovation. Studies indicate that the compliance cost reductions associated with adoption of an emission fee could be large.[219] Second, an emissions fee approach would eliminate or minimize technical and design constraints on products and processes, promoting both market and social innovation.[220] Third, a fee system would put old and new sources on an equal footing, and it would not impose a disproportionately greater burden on firms that could "afford" it, thereby promoting market innovation.

217. However, the selection of tools is not a technocratic exercise. *See* note 21 *supra*. Developing a representative measure of the social performance of pesticides would simplify the task of providing effective incentives for social innovation. In the regulation of gasoline mileage, Congress already has adopted a fee-type system. But its effects are difficult to determine, partly because of the coincident impact of gasoline shortages and sharply rising gasoline prices. A gasoline tax could also be levied on the vehicle operator rather than the manufacturer to penalize poor fuel economy in proportion to vehicle miles driven.

218. *See* ACKERMAN, *supra* note 181, at 223-59.

219. *See* F. ANDERSON, *supra* note 176, at 34; A. KNEESE, *supra* note 176, at 162-66, 181.

220. For example, development of alternative engine technologies could be greatly stimulated by an emission-fee system in lieu of uniform state-of-the-art regulatory controls. *See* Mills & White, *Government Policies Toward Automotive Emissions Control*, in APPROACHES TO CONTROLLING AIR POLLUTION 362 (A. Friedlander ed. 1978).

Fourth, a fee system could substantially reduce uncertainty and decisional costs and delays by reducing case-by-case determination of regulatory requirements for new industrial plants, thereby promoting innovation. Fifth, a fee system would provide a positive and continuing incentive for social innovation by rewarding firms that achieved higher performance levels. Equally important, it would not penalize those who achieve a given level of performance at less cost. Fee payments would also lead consumers to shift purchases away from high polluting products or from goods manufactured through high polluting processes, because their prices would tend to be higher.

These considerations cumulatively build a powerful case for widespread use of a fee system to promote social and market innovation while ensuring improved social performance. Inevitably, however, there are drawbacks. The most substantial disadvantage is the loss of control assurance created by uncertainty concerning the level of performance that a given fee will elicit. Under a fee system, control is a function of individual firm responses to a fee schedule based on their individual control costs; these reactions cannot be predicted in advance by the fee-setting authority without gathering extensive information on firms' abatement costs. Where a given level of control is necessary to prevent serious threshold effects from occurring, regulatory controls are preferable because they offer more certainty.[221] The problem of uncertain performance in a fee system is particularly significant in the pollution control context when it is important to prevent localized excursions above ambient standards—"hot spots"—from occurring anywhere in a large region. A fee system is ill equipped to prevent local "bunching" of pollution sources without introducing cumbersome constraints.[222] These shortcomings in a fee system are not, however, particularly significant in many pollution control contexts that lack sharp thresholds and involve area-wide rather than localized effects. Photochemical oxidants, sulphates, and other fine particulates, and, at lower concentrations, toxic water pollutants, fall within this category.[223]

Setting the fee is also difficult. The responsible agency cannot be directed simply to make the fee equal to the social costs of pollution; too many logical and practical pitfalls intervene.[224] Setting a fee just

221. *See* Roberts & Stewart, Book Review, 88 HARV. L. REV. 1644, 1650-51, 1653 (1975).

222. *See id.* at 1652-53.

223. Moreover, where it is important to avoid thresholds or to achieve specific control levels, command-and-control regulations can be imposed to assure a minimum level of control and fees can be added for any remaining emissions. For example, outside of prevention of significant deterioration areas where it may be critically important to ensure that allowed increments are not exceeded, a system of emission fees on top of new-source performance standards might be substituted for lowest-achievable-emission-rate requirements. This combination would retain most virtues of a fee system, although, in some instances, to a reduced degree.

224. *See* Roberts & Stewart, *supra* note 221, at 1647-50.

large enough to call forth sufficient control efforts to reach a pre-established target level of ambient concentrations also poses problems.[225] The practical goal of a fee system is to reduce the growth of total emissions loadings across large areas in a cost-effective manner that also provides broad-based incentives for social innovation.

This suggests that fees ought probably to be set by the legislature, phased in gradually, and reassessed on a regular timetable—perhaps every five years—long enough to provide predictability but short enough to allow adjustment in light of experience.[226] The practical difficulty with this approach is that a fee would be widely perceived as a politically unpalatable increase in taxation. Also, disposing of the fees, which might generate sizable revenues, could create political controversy. The alternative is to delegate the setting of fees to regulatory agencies in accordance with general criteria.

A fee system presents several other possible objections. It may not lead firms to adopt social innovations that a regulatory agency could establish as "available." But foregone improvements should not be frequent if the fee is set close to the stringency of the comparable command-and-control regulatory system. Moreover, "enforcement loss" should be outweighed by dynamic features of the fee system, which promises to stimulate social innovation that permits higher levels of performance at less cost.

A fee system may lead to higher total outlays by firms even though it lowers total abatement costs, because firms under a fee system must pay for remaining emissions that are "free" under a regulatory approach. This result could reduce market innovation as well as explain firms' opposition to fee systems. But this difficulty could be avoided by returning a portion of fee payments to firms based on a variable, such as production, other than pollution levels. Political constraints might dictate that rebates be earmarked for investment in social innova-

225. *Id.*

226. Using taxes or fees in the pollution control context poses some institutional problems of jurisdiction—would such measures be considered by Congress' taxing committees or its environmental regulatory committees; would the EPA or the Internal Revenue Service administer them? Environmental advocates have worried that the politics of a fee system would lead to lower levels of environmental quality because debate over the appropriate level of incentives would focus on costs rather than on underlying moral imperatives as is the case with a regulatory system. They are also concerned that the political difficulties of obtaining future increases in fees will remove the possibility of maintaining environmental quality in the face of inflation and continuing industrial development. The first objection has a counterargument. A lower level of control may well be appropriate in light of the costs of achieving controls. Furthermore, any tendency to lower environmental quality will be at least partially offset by reduced abatement costs attributable to the adoption of a fee system that stimulates social innovation and thus enables society to afford higher levels of control. The second objection also applies in part to regulatory controls and can be alleviated by indexing fee levels to inflation as well as to additional emission discharges from new or expanded plants.

tion.[227] This concession might pacify opponents of fees who claim that fees represent a new tax burden or a politically unwelcome set of spending decisions.

A fee system may lead to plant shutdowns and other forms of disruption by imposing heavier burdens on firms and industries less able to "afford" them. A cautious Congress may exempt these marginal firms and industries from fee requirements, undercutting the virtues of a fee approach. However, disruptions could be minimized by slowly phasing in a fee system.

Fee systems are virtually untried, whereas the regulatory system, despite its shortcomings, has arguably been shown to work. A related concern is that a shift to a fee system would introduce a whole new generation of implementation and adaptation uncertainties just when many uncertainties associated with a command-and-control regulatory system are being resolved. The basic question however, is whether regulatory approaches can stimulate the social innovation needed to maintain or improve environmental quality in the face of continued economic development and whether they can do so without incurring unacceptable costs, including adverse impacts on market innovation. Strong logical grounds indicate that a fee-based system would do a better job of stimulating social innovation. This claim is backed up by evidence based on fees imposed on industrial waste discharges into municipal treatment systems that indicate fee-type incentives encourage substantial innovation.[228]

Critics of fee systems frequently point to our present lack of a continuous monitoring capability upon which a fee system depends. There are two responses. First, a fee system does not necessarily require such capability. In lieu of continuous monitoring, the existing regulatory system identifies emission reductions associated with a particular control strategy, such as low sulfur fuel or scrubbers. A regulated firm's emissions are ascertained, often on the basis of process inputs, such as coal of a certain sulfur content. Its uncontrolled emissions are also determined. The firm is then credited with the reduction in emissions associated with the installation and operation of a particular control

227. Some precedent for such an approach can be found in §§ 113(d)(1), (4) and 120(d) of the Clean Air Act Amendments of 1977, 42 U.S.C. §§ 7413, 7420 (Supp. III 1979), providing that compliance expenditures may be credited against noncompliance penalties. Competitive displacements may nonetheless occur. In principle, such displacements reflect comparative social performance in avoiding external costs that should legitimately be included as a cost of doing business. However, where the disruptions are judged unacceptable, they can be dealt with by a "disruption tax credit" or subsidy for the firms or industries at risk. The fee approach may make these exceptions more visible and therefore more closely scrutinized than the regulatory approach.

228. *See* F. ANDERSON, *supra* note 176, at 65. Uncertainty over the performance of fee systems can be minimized by phasing in a system of fees on top of existing regulatory requirements, gradually introducing charges on emissions that are not "free."

strategy such as flue gas desulphurization scrubbers. The same approach could measure emissions under a fee system. Enforcement and monitoring problems have apparently not represented a serious obstacle to the administration of effluent charge systems in Europe.[229]

The second response is that improvements in monitoring capability are eventually needed under any set of government pollution control incentives and that adoption of a fee system could spur the needed improvements. The current regulatory system has been undermined by regulators' inability to monitor and enforce the proper operation and maintenance of abatement technologies after they have been installed.[230] The existing regulatory approach has even failed to effectively use existing monitoring technology. Firms probably would adopt existing and future technology much faster under a fee system. Since fees presumably would be keyed to conservative assumptions concerning verification of emissions performance, firms whose emissions were lower or could be reduced at low cost would have powerful economic incentives (entirely lacking under a regulatory system) to develop the monitoring capability to verify their superior performance and reduce their fees.

Also, a fee system would highlight the importance of assured monitoring capability, encouraging agencies to give its adoption and development a higher priority than it now enjoys.[231]

In sum, fee systems promise substantial advantages over command-and-control regulatory systems for encouraging market and social innovation where avoidance of particular thresholds or local "hot spots" is not a concern and where broad-scale incentives to develop cheaper, but environmentally superior products and processes, are a priority. Problems that need to be addressed are the partial recycling of fee payments, monitoring, and determining initial fee levels and future adjustments.[232] Congress already has shown itself willing to experiment with new forms of economic incentives within regulatory contexts

229. R. JOHNSON & G. BROWN, CLEANING UP EUROPE'S WATER (1976); A. KNEESE, *supra* note 176, at 109-10.

230. *See* note 193 *supra*.

231. The automobile emissions control and fuel economy regulatory experience is instructive. Because surrogate measures of performance based on the technological characteristics of the automobile product are not very reliable (and also because direct monitoring may be somewhat easier), much greater attention has been paid to development of emissions monitoring capability for automotive performance than for stationary source performance.

232. There are a miscellany of additional problems not discussed in the text: fees, unless they are set at unrealistically high levels, may not produce the desired response from oligopolistic industries; also, fees will involve uncertainties because they are likely to change according to society's assessments of the costs and benefits of achieving various levels of environmental quality. While these difficulties are significant, they do not count as a sound reason for disfavoring fees or fees "on top" of regulation relative to a pure command-and-control system, because all these difficulties apply with equal or greater force to regulatory systems.

by including graduated penalties for noncompliance in automotive fuel-economy regulations; authorizing administrative development of a graduated penalty system for heavy-duty vehicle pollution control; and enacting a statutory system of noncompliance penalties for stationary sources of pollution, designed to tax away the economic incentives for noncompliance. None of these schemes represents a true fee or tax system because they are premised on achievement of a specific, administratively determined performance level for each source. Furthermore, they do not impose any charge once that target level is achieved. Nonetheless, these schemes show congressional recognition of the virtues of economic incentives, including fees proportional to social performance. Heightened congressional awareness of the importance of social and market innovations should improve the prospects for adoption of some form of true fee system, either standing alone (most likely as a tool for dealing with previously unregulated pollutants such as sulfates) or as a hybrid "add on" to existing regulatory requirements. However, political opposition to fees as a new "tax" is likely to persist.

b. Transferable Pollution or Other Nonperformance Rights

A system of transferable pollution rights would set a total permissible number of units of emissions or other measure of performance such as m.p.g. fuel economy for regulated firms in a given region or period and allow the permits to be bought and sold by firms whose products or processes were subject to this system. A firm would have to acquire permits equal to the amount of its pollution or nonperformance or face a shutdown. This system, like a fee system, requires a uniform quantitative yardstick for measuring performance—a requirement that would, as a practical matter, preclude its application to chemicals and automotive safety. Most theoretical and empirical work in transferable rights has been done on air pollution control.

In theory, a transferable pollution rights system would combine many of the best features of regulatory controls and fees. Like a regulatory system, it would assure that total emissions would not exceed a certain amount, although "bunching" of pollution sources that produces local "hot spots" could create problems unless transfer limitations were imposed. On the other hand, the system would function like a fee system from the perspective of individual firms by requiring payment of a fee equal to the price of a one-unit permit, in turn set by supply and demand for each unit of pollution or nonperformance. Therefore, it would offer the virtues of a fee system by providing positive incentives for social innovation and by reducing constraints and abatement outlays that discourage market innovation.

Moreover, a permit system, unlike a fee system, would not require

constant administrative or legislative tightening to maintain environmental quality in the face of inflation and continuing industrial development. As demand for pollution rights increased with growth, the price would rise, leading to higher levels of control by firms. Existing pollutant levels could be reduced by "depreciating" permits over time according to a predetermined schedule. A transferable permit system would make impersonal market forces rather than air pollution control officials determine whether new firms could enter a given area and how the resulting abatement burdens on existing sources should be allocated. Air pollution control officials are ill equipped to make such industrial development decisions.

A permit system could also reduce delay and decisional costs,[233] as well as resolve a regulatory dilemma. Some old sources may have the technical capability to reduce emissions relatively cheaply but cannot "afford" to do so. A regulatory system often will not require the reduction because of shutdown fears. But under a trade-off system, a new source seeking pollution permits could provide the financing needed for emission reductions by existing sources. If permits were simply given to existing sources rather than auctioned off, the political opposition generated by fees as a new and disruptive form of "tax" could be minimized.

The trade-off alternative initially seems to represent an extremely attractive option, but no direct evidence indicates that markets in pollution or nonperformance rights can be created and made to function. The closest precedent is the "trade-off" principle developed by EPA in 1976 to deal with the location of new industrial sources in areas that had failed to achieve national ambient air quality standards. Congress incorporated the concept into the 1977 Amendments to the Clean Air Act.[234] The trade-off scheme allows new or expanded sources to locate in nonattainment areas, provided they purchase or otherwise arrange for more-than-compensating reductions from existing sources. Particularly where "banking" is allowed, the opportunity for existing sources to secure compensation for trade-offs creates an incentive for social innovation similar to that under a pure transferable permit system. A trade-off system, like a transferable permit system that gives permits to existing sources, requires outlays only by new entrants or by existing sources who must reduce emissions. This favorable treatment of existing sources reduces the potential for socially unacceptable financial disruption and political opposition from those wary of a new "tax."

233. *See* R. STEWART & J. KRIER, *supra* note 6, at 587-95. However, delay and uncertainty would be introduced if officials reviewed each trade-off on a case-by-case basis to determine the precise air quality impacts of a particular trade-off and to decide whether those impacts are acceptable. The terms of trade should be specified in advance by regulation.

234. *See* note 9 *supra*.

In actual practice, no outright purchases of trade-offs apparently have occurred, although in some private barter agreements the new source has assumed the costs of reducing emissions from the existing source.[235] More frequently, however, trade-offs have been arranged through regulatory agencies that have required or persuaded an existing source to reduce emissions to "make room" for a new source.[236] No "open market" in pollution rights has developed, partly because of many remaining regulatory uncertainties, including the ratio of trade-offs required; the determination of emissions to be attributed to the new source;[237] problems posed by trade-offs between noncontiguous sources; the duration and policing of the entitlement; possible credit allowances for emission reductions from old sources that could be expected to shut down for purely economic reasons within a few years; and the "thinness" of the relevant markets.[238] Resolving these issues would involve substantial transitional uncertainties.[239] At present, trade-offs resemble a barter market in which the parties to each transaction have the burden of demonstrating to an administrative agency the precise character and equivalency of the goods exchanged and the fairness of the trade to the community. Another pervasive inhibition to the creation of active markets is the overhanging shadow of regulatory agency authority to require further emission reductions and thereby diminish the value of pollution rights, a possibility that would leave rights not currently in use particularly vulnerable.

The threat of more stringent regulatory controls can undermine

235. An advertisement offering emissions rights for sale appeared in the Wall Street Journal, Dec. 19, 1980, *reproduced in* W. DRAYTON, *supra* note 130.

236. W. DRAYTON, *supra* note 130.

237. For example, should pollution from increased generation of electricity needed to serve a new plant be counted?

238. The thinness problem can be alleviated by expanding the geographic area within which trade-offs or transfers are permitted, but this may lead to "bunching" of pollution sources that produces "hot spots." Bunching may cause little concern for pollutants such as sulfates that cover broad geographic areas and do not appear to exhibit sharp threshold effects, but such situations do not call into play a distinct advantage of a transferable permit scheme over a fee system—assurance that emissions will not exceed a given amount.

239. Two California cases involving proposed trade-offs provide examples. Sohio's proposed oil transfer facility in Long Beach consumed several years of study and wrangling over the emissions to be counted against the project. Likewise, Wickland's proposal for a petroleum storage and distribution facility on the east side of San Francisco Bay was held up for well over a year because the trade-off would come from a source on the west side of the Bay. East Bay residents protested that their air quality would deteriorate. *See Pollution Trade-Off Mired in Disagreement*, Contra Costa Times, Sept. 27, 1979 at 6, col. 1. The permit for the facility was finally denied because uncertainties in calculating the baseline emissions from the San Francisco source were resolved against Wickland, which must begin the permit process all over again. While these examples may not be altogether representative, they illustrate the difficulties of developing a market in pollution rights, particularly when trade-offs or transfers are tied to a regulatory scheme based on ambient air quality. Project opponents can almost always show that a trade-off will involve some deterioration in local ambient air quality.

the incentive for social innovation that a trade-off system would otherwise provide in yet another way. A firm with several similar sources may fear that if it develops an innovative control method for one of its sources in response to a trade-off or transfer opportunity, the regulatory authority will promptly require its use for the other sources. The resulting compliance burden may outweigh the gain from the trade-off or transfer.[240]

Even if an active market emerged, fluctuations in price and availability could create substantial uncertainties and adversely affect innovation. One as yet untried approach to alleviate uncertainty would have a government agency act as a central "banker" of emission rights, buying and selling rights for cash at a price equal to the estimated least-cost opportunity for reducing emissions within the air basin.[241]

EPA's "bubble" policy presents a restricted version of the transferable permit system. It allows one unit in a plant or industrial complex to increase pollution without complying with special emission standards applicable to new sources, provided that more-than-compensating reductions of emissions are made elsewhere in the same plant or complex.[242] In effect, transfers of pollution rights are permitted, but only within a given plant or complex. This approach avoids many of the transaction costs and uncertainties involved in a more general scheme. However, it does so at the price of limiting the innovation incentives.

Other problems in a transferable permit system include the initial allocation of permits, their duration, monitoring compliance, control

240. For this reason, Southern California Edison strongly resisted a trade-off agreement with Sohio in which Sohio would finance installation of an innovative nitrogen oxides control technology on one of Edison's generating plants. It only agreed after state regulatory authorities exerted strong pressure. In the Wickland case, the proposed trade-off involved installation of new controls on a dry cleaning plant. It now appears that these controls will be imposed on all dry cleaning plants in the region. This development has fueled objections to the trade-off on the ground that it gives an unfair competitive advantage to the dry cleaning plant involved in the trade-off, which will be relieved of compliance costs that its competitors will have to bear. The regulatory scrutiny accorded the existing source may also discourage trade-offs. Close examination may often reveal that existing emissions substantially exceed regulatory standards.

241. *See* 44 Fed. Reg. 3274 (1979). EPA has permitted banking and is studying the establishment of "market maker" institutions.

242. Court rulings have to some extent constrained the availability of the bubble. *See* decisions cited note 93 *supra*. The bubble approach appears to reduce compliance and decisional costs and alleviate technical constraints, all of which would promote market innovation. *See* W. DRAYTON, *supra* note 130. Environmentalists have complained that the emission reductions from existing units encouraged by the bubble scheme could have been independently identified and enforced under a regulatory scheme and that by waiving control requirements that otherwise would apply to new units, the bubble system results in more pollution. This objection raises in different guise the "loss of control" debate discussed earlier in the context of fees for new sources. *See* text accompanying notes 221-23 *supra*. However, the incentive for social innovation under the bubble is less pervasive than under a fee system. The same objection has been leveled at the trade-offs approach.

loss, the market behavior of regulated or public monopolies, and antitrust problems. Permits could simply be issued to existing sources in proportion to their existing permitted emissions; this, in effect, is the method used to allocate implicit entitlements in a regulatory system. It is also the method used under the current trade-off approach. However, objections might be raised to this practice in the context of transferable permits, which would constitute a form of property that the holder could convert into cash. Permits also could be auctioned off, but this alternative could create serious disruptions.

Allowing permanent duration for permits would impede future improvements in environmental quality, for revocation of permit rights might well be held to be a compensable "taking."[243] This difficulty could be circumvented by limiting duration, but such a step would create uncertainty. Alternatively, permits could be amortized at a fixed rate over time.

Monitoring and "control loss" problems are similar to those already discussed for the fee system.[244] A recent study of the Los Angeles basin concluded that monitoring and enforcement of a transferable permit system for several major air pollutants would not be appreciably more difficult or costly than monitoring and enforcement of the existing regulatory system.[245] Antitrust problems—"hoarding" or refusing to sell permits in order to deny entry to a competitor—could in principle be dealt with under existing antitrust laws.[246]

In summary, the difficulties in a transferable permit or trade-off approach are most acute when it is employed in conjunction with a regulatory approach that prohibits any excursions above an ambient standard anywhere in a region. In that context, administrative clearance of each trade-off or transfer transaction is required to ensure ac-

243. Payment of compensation might be appropriate because it would force the legislature to consider whether the benefits of improved environmental quality outweigh the costs. However, the same argument could be made in the context of regulation, where compensation is generally not required when controls are tightened. Also, the argument may assume an entitlement to pollute—a controversial premise.

244. Congressional concern over "control loss" is reflected in the requirement that new sources in nonattainment areas not only obtain trade-offs, but also install best-available-control technology. Clean Air Act § 173, 42 U.S.C. § 7503 (Supp. III 1979). This requirement may add to delay and uncertainty and therefore undercut the potential advantages of a transfer/trade-off system.

245. R. Hahn, Marketable Permits: What's All the Fuss About? 17-19 (Nov. 11, 1980) (draft of paper on file with author).

246. However, pollution permits may present special difficulties (is alleged "hoarding" simply a prudent hedge against the inherent uncertainties of the scheme?), and regulatory agencies' involvement could raise antitrust immunity problems. But functionally similar antitrust issues are presented under current regulatory approaches, which empower regulatory officials to decide the antitrust issues upon competitors' entry into given regions. Existing firms may well try to influence such decisions against competitors' entry.

ceptable ambient quality. The geographic range of trade-offs or transfers must be restricted in order to protect that quality, creating "thin market" problems, and the disincentive of more stringent regulatory controls based on trade-off or transfer-induced innovations reappears. To avoid these problems, transfers could be "decoupled" from ambient standards and regulations by permitting transfers to occur over a broad region or water basin without policing the effects of individual transactions on ambient quality. The aim would be to limit total loadings of emissions over a broad area. This approach would be appropriate for pollutants such as sulfate or photochemical oxidant precursors, whose effects are region-wide. A region-wide transferable permit system would offer several advantages over the fee system alternative in dealing with broad-scale emission problems. It avoids the political and administrative difficulties involved if the government is setting and revising fees, although the difficulties in determining appropriate emission levels remain. The possibility of "grandfathering" existing sources enhances its political acceptability.

c. Damage Awards

In theory, damage awards secured by individual victims through court litigation represent the ultimate form of pollution or noncompliance fees assessed on a decentralized basis without cumbersome bureaucratic machinery. The threat of *ex post* damage awards could serve as a powerful incentive to social innovation with minimal constraints on market innovation. In practice, however, this approach faces substantial problems: long latency periods for many of the harms in question; difficulties in establishing causation when many factors are potentially responsible for a given illness, injury, or death; limited technical competence of the courts; short time horizons of some corporate decisionmakers; costs of litigation; and the substantial potential for inconsistent results.[247] These considerations point to the need for a centralized system of controls or incentives administered by agencies with ongoing technical and monitoring resources.

Damage awards might nonetheless play a supplemental role in dealing with acute harms from toxic chemicals[248] or in auto safety, pro-

247. *See* SIX CASE STUDIES OF COMPENSATION FOR TOXIC SUBSTANCES POLLUTION (1980) (Report for the Senate Comm. on Environment and Public Works, Ser. 96-13); Pierce, *Encouraging Safety: The Limits of Tort Law and Government Regulation*, 33 VAND. L. REV. 1281 (1980). Greater use of a damage award would not necessarily benefit market innovation in all cases. While, as noted in the text, some corporate decisionmakers may be risk takers, others may be notably risk averse. The possibility of infrequent and unpredictable, but quite large damage awards, may substantially inhibit development of new products and processes.

248. *See* Soble, *A Proposal for Administrative Compensation of Victims of Toxic Substance Pollution: A Model Act*, 14 HARV. J. ON LEGIS. 683 (1977).

vided that the awards could be integrated into insurance systems that offered appropriate incentives for firms.[249]

B. Alternate Decisional Processes

1. Modify Current Practice

Several possible modifications of the current system of regulatory decisionmaking could render it more responsive to innovation concerns. Congress already has considered some of these changes.

Existing procedural formalities could be streamlined and the scope of judicial review reduced. Despite the Supreme Court's *Vermont Yankee* ruling,[250] the elaboration of procedural requirements in notice-and-comment rulemaking has created more delay, complexity, and procedural formality.[251] If procedural requirements were reduced and the associated "hard look" standard of judicial review were cut back, agencies could return to the "New Deal" model of administration. Under that model, agencies had great flexibility in gathering data and views; negotiation and compromise with affected interests was facilitated; and procedural formality and judicial review were minimal. Such steps would promote speedier and less costly proceedings. They also might facilitate informal discussion and negotiation that would encourage less restrictive and burdensome regulations.

Such changes, however, could also have adverse consequences for market innovation. Regulated firms have used existing procedures to challenge the technical or economic justification for burdensome regulations and prevent, delay, or modify their adoption. Greater informality might also allow regulation-minded agencies to impose more burdensome requirements more easily. Abandoning existing procedures without substituting other quality control measures could adversely affect the technical soundness of regulations and their responsiveness to compliance problems.

Reducing procedural formality would also increase the fear, reflected in the current system, that regulatory agencies will be "cap-

249. A useful system of incentives could emerge to supplement existing command-and-control regulatory systems and to moderate the risk averse spirit with which they are carried out if firms were required to have "outside" insurance for such harms; if liability rules were adjusted to provide for effective victim recovery under crude but serviceable rules of thumb; and if the relative social performance of firms, as measured by potential liability exposure, could be reflected in merit ratings for premiums. The effort might stimulate development by the private insurance market of a social performance fee. Despite the many "ifs" involved, the potential of the idea seems to justify further study.

250. Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Counsel, 435 U.S. 519 (1978).

251. *See* S. BREYER & R. STEWART, *supra* note 52, at 499-524; sources collected in Note, *Rethinking Regulation: Negotiation as an Alternative to Traditional Rulemaking*, 94 HARV. L. REV. 1871, 1871 nn. 2, 3 & 4 (1981).

tured" by regulated firms. An important reason behind the adoption of more formal procedures was to prevent informal accommodations that assertedly promote "capture" and exclude environmental or consumer groups.[252]

A move to more informal procedures may well be desirable.[253] As developed below, however, such a change should be made only in connection with more fundamental alterations in the conception and machinery of the regulatory process.

The opposite approach to modifying the current system would be to add additional procedures and review mechanisms to encourage greater agency attention to innovation impacts. Because of their institutional mission, regulatory agencies often pay little attention to the impact of their decisions on market and social innovation. An agency whose prime goal is environmental protection has no stake in market innovation. Regulatory burdens are likely to be defined in terms of plant shutdowns and the gross magnitude of compliance outlays rather than the invisible costs of foregone innovation opportunities. In the case of social innovation, agencies face strong pressures to demonstrate short-term progress by enforcing diffusion of "available" technology rather than pursuing the longer-term, more elusive goal of promoting environmentally superior technologies.

Procedural formalities could be refocused on innovation concerns, with courts and the "external" adversary process supplying the missing corrective incentives. For example, a statute might identify social and market innovation impacts as specific topics to be addressed through

252. *See, e.g.*, Home Box Office, Inc. v. FCC, 567 F.2d 9 (D.C. Cir.), *cert. denied*, 434 U.S. 829 (1977); Environmeutal Defense Fund v. Ruckelshaus, 439 F.2d 584 (D.C. Cir. 1971); Moss v. Civil Aeronautics Board, 430 F.2d 891 (D.C. Cir. 1970).

253. For example, the statutory provisiou of trial-type procedures in pesticide legislatiou, 7 U.S.C. §§ 136(a), (d) (Supp. III 1979), seems anomolous, given the use of far less formal procedures in automobile and other pollutiou regulation involving a substantially similar combination of technical and policy issues. To some extent, however, use of trial-type hearing procedures has already been, or could be, streamlined by EPA within existing statutes by use of presumptions, shifted burdens of proof, and resolution of generic issues through rulemaking. *See, e.g.*, Environmental Defense Fund Inc. v. EPA, 548 F.2d 998 (D.C. Cir. 1976), *cert. denied*, 431 U.S. 925 (1977). Many important issues are already resolved in less formal suspension or waiver proceedings. Further moves towards more informal procedures would reduce delay and decisional costs and might eucourage EPA to undertake more cancellation procedures and undermine manufacturers' ability to maintain existing products on the market by invoking—or threatening to invoke—formal procedural rights. However, more informal procedures also would hamper the ability of environmental groups to develop their cases through cross-examination and discovery. Current procedural requiremeuts make it more difficult for EPA to remove existing products from the market, which gives manufacturers greater assurance of profitable returns from a successful product and thereby eucourages investmeut in new products. Elimination of such procedural requirements might therefore discourage innovation.

As developed below, *see* text accompanying notes 289-301 *infra*, the most promising improvement in pesticide cancellation procedures may be greater use of technical advisory committees.

adjudicatory or rulemaking procedures. Alternatively, a separate procedure analogous to the environmental impact statement could be directed specifically at innovation impacts.

This approach is not a sound one. Our understanding of the relation between regulation and innovation is too fragmentary and uncertain to make the procedural game worth the candle. The proposal would add to the length and complexity of administrative proceedings and multiply the grounds for judicial review without promising substantial improvement in agency policies. Consider, for example, the difficulties in litigating the impact of a particular "best available technology" effluent limitation on market and social innovation in a particular industry. Paradoxically, such efforts to ameliorate adverse regulatory impacts on innovation might well exacerbate them by adding considerably to decisional costs.

Reliance on legal procedures and litigation, however, is not the only possible way to promote more consideration of innovation impacts. The steps taken within the executive branch over the past several years to make regulatory agencies pay attention to compliance outlays[254] suggests that similar steps might be extended to promote consideration of innovation impacts. The use of formal procedures in the existing system of review as a quality control mechanism is arguably

254. Several developments have encouraged regulatory agencies to pay more attention to compliance costs: the role of the Commerce and Energy Departments in directing attention to regulatory burdens; the formation within the executive branch of reviewing bodies, such as the Regulatory Analysis Review Group (RARG) and the Counsel on Wage and Price Stability (COWPS), to review regulatory compliance costs and their justification; and the creation within regulatory bodies such as EPA of analytic capability to examine compliance costs and develop more cost-effective regulatory strategies to respond to potential criticism from the Commerce, Energy, RARG, and COWPS. *See* DeMuth, *The White House Review Program*, REG., Jan./Feb. 1980, at 13, 15-18; Miller, *Lessons of the Economic Impact Statement Program*, REG., July/Aug. 1977, at 14-21.

The Commerce and Energy Departments could include market innovation impacts as an important element of its analyses and advocacy; RARG or a similar body could also review such impacts. These developments would in turn provide an incentive for EPA and other regulatory bodies to turn their analytic capabilities and strategic thinking to innovation impacts. A different institution—perhaps an expanded and revitalized Council on Environmental Quality—with a social performance mission might effectively serve as a social innovation advocate. The gains from this alternative should not be exaggerated. COWPS and RARG review has not achieved any direct override or alteration of regulatory choices. Where the Occupational Safety and Health Commission or EPA has insisted upon a given regulation despite COWPS or RARG criticisms of unjustified compliance costs, the regulatory agencies have prevailed, partly because they have better organized and more vocal political constituencies than do the reviewing agencies. *See* DeMuth, *The Regulatory Budget*, REG., March/April 1980, at 29.

Substantive override would require not only political mobilization but a substantial increase in the staff of the reviewing agencies. The number of intensive reviews that can be performed without duplicating the work of the five agencies is limited. On the other hand, the review process and the agencies' reactive development of their own in-house analytic capacities do appear to have sensitized regulatory agencies to compliance cost impacts.

attributable to its reliance upon generalist judges who are ill-equipped to deal with technical issues, and who seek to compensate for their lack of technical competence by imposing procedural formalities.

Use of specialized reviewing courts or nonjudicial review boards, located within the executive branch and composed of technically qualified individuals, might improve the soundness of regulations and reduce the use of procedural formalites at the agency level. A specialized reviewing tribunal could, however, invite excessive partisan conflict in the selection of its members. Such a tribunal would have a narrower experience and outlook than the courts of general jurisdiction. On the other hand, a supplemental executive review body, analogous to the Regulatory Analysis Review Group, could contribute to the technical soundness of agency decisions without entirely displacing review by the regular courts.[255]

2. *Negotiated Standard Setting*

Reliance on informal negotiation and bargaining by regulatory agencies, industry, and public interest groups to establish and implement regulatory policy promises several advantages over the current system of more formal proceedings. These advantages include reduced decisional costs, uncertainty, and delay, and fewer unnecessary or unjustified technical constraints and compliance burdens. There are several possible ways to promote informal negotiations in standard setting.

Under a collective bargaining model, standards would be set by informal negotiation between the agency, regulated firms, and other interested groups.[256] In order for such an approach to succeed, Congress would have to delegate broad discretion to administrative agencies; the current scope of judicial review would have to be curtailed; the formality of decisional processes would have to be substantially relaxed, and prohibitions against off-the-record communication would have to be removed. Such a drastic departure from current procedures would conflict with the distrust of agency discretion that underlies present arrangements.

Securing agreements binding on all affected interests also would present difficulties in the regulatory context.[257] By contrast, collective bargaining in the labor field involves on the one side employers and, on

255. *See* ACKERMAN, *supra* note 181, at 147-61.

256. Professor John Dunlop at Harvard University has suggested the use of a collective bargaining model for administrative decisionmaking. *See* J. Dunlop, The Negotiations Alternative to Markets and Regulation 65 (1979) (paper on file at Harvard Law School Library). *See generally*, Note, *supra* note 251.

257. Agreement to a particular solution by a given consumer or environmental advocacy organization would not preclude other organizations or individuals harmed by assertedly inadequate agency regulation from obtaining judicial review to challenge such an agreement.

the other, unions that can bind all employees under the legal compulsion of the exclusive representation rule.

Another informal negotiation alternative would be to use consensus standards through procedures like those currently used by private nonprofit organizations such as the National Institute for Testing and Materials and the National Fire Protection Association.[258] These organizations sponsor the development of voluntary standards on matters such as product safety or materials specifications. Proposed standards are publicly noticed, then informally examined through committees composed of technically knowledgeable representatives of manufacturers, suppliers, distributors, consumers, and interested government bodies. Efforts are made to accommodate and respond to dissenting views. A standard, once adopted, is expected to be observed, although neither a standards organization nor its members can ordinarily compel adherence.

Consensus standard setting would offer significant advantages if it could be extended to environmental, health, and safety regulatory programs.[259] The process expands the agency's technical resources by drawing on the specialized knowledge of those in the private sector. It promotes identification of practical compliance problems and of unnecessarily burdensome constraints or costs. If the consensus process promotes agreement among interested parties, subsequent formal proceedings probably could be streamlined and judicial review avoided.

However, several considerations argue strongly against using the existing voluntary standards process for environmental regulation. The consensus process would be inappropriate for individual product or process screening because of the obvious conflict of interest between the firm whose product or process was being screened and its competitors. Industry-wide standards present the danger that the consensus process will be dominated by regulated industries seeking to reduce

258. *See* R. DIXON, STANDARDS DEVELOPMENT IN THE PRIVATE SECTOR: THOUGHTS ON INTEREST REPRESENTATION AND PROCEDURAL FAIRNESS (1978); Hamilton, *The Role of Nongovernmental Standards in the Development of Mandatory Federal Standards Affecting Safety or Health*, 56 TEX. L. REV. 1329 (1978).

259. This process could be adapted to regulatory programs in several ways. *See generally* P. HARTER, REGULATORY USE OF STANDARDS: THE IMPLICATIONS FOR STANDARDS WRITERS (1979) (National Bureau of Standards Study GCR 79-171). The responsible agency could simply decline to adopt mandatory standards in a given area after judging voluntary consensus standards to be adequate. However, many regulatory programs statutorily require adoption of mandatory standards. In such cases the ageucy could adopt, with or without modification, the standard generated by the consensus process as a mandatory standard. Alternatively, the agency, following the practice of the Nuclear Regulatory Commission, could adopt the consensus standard as a "regulatory guideline." Compliance with a consensus standard would be accepted by the agency as compliance with a generic regulatory requirement. Firms would still have the freedom to demonstrate compliance with the latter requirement in other ways. *See id.* at 62-63.

regulatory standards to the lowest denominator acceptable to all firms in the industry. Recent studies of the existing voluntary standards process indicate that dilution has not been a major problem.[260] But the areas where voluntary consensus standards have been adopted—such as product standards and fire codes—are generally those in which firms already have a substantial economic incentive to adopt and adhere to voluntary standards.[261]

These incentives are largely absent in environmental regulation.[262] Moreover, the adoption of uniform environmental standards for industrial pollution could have drastically different effects on firms within an industry. The disparity could create serious obstacles to consensus.[263] These factors explain why the threat of mandatory government regulation has not spurred the adoption of voluntary environmental standards. From the viewpoint of social innovation, firms are not likely to

260. *See* notes 258-59 *supra*. *But see* Jackson, *The Subject Was Standards: The Federal Government and Safety in the 1940's—and 1970's*, 10 AKRON L. REV. 185 (1976).

261. Apart from exclusion of competitors and raising entry barriers, these incentives include: cost savings made possible by standardization, reduced transaction costs attributable to the use of standard specifications, promotion of consumer demand for an industry's products through product quality standards, avoidance of legal liability in private damage actions through adoption of and adherence to standards as evidence of due care, and avoidance of even more costly and burdensome standards imposed by government through a mandatory system of regulation. *See generally* REGULATING THE PRODUCT: QUALITY AND VARIETY (R. Caves & M. Roberts eds. 1975).

In areas where consensus standards serve as the basis for regulation—for example, medical devices and nuclear generating plant safety—one or more of these incentives generally operate with substantial force, exerting considerable independent pressure for the adoption of effective self-regulatory measures.

A perennial difficulty in the existing consensus process is securing technically knowledgeable representation of consumers and other diffuse interests. *See* Hamilton, *supra* note 258, at 1379-86. In many regulatory areas involved here, this particular difficulty is alleviated by the presence of experienced environmental and consumer advocacy groups. However, such groups are not familiar with the voluntary standards process and have already developed adversary relationships with regulated firms. Also, their resources are limited. Finally, as noted already, they cannot bind other consumers and environmental advocates. These characteristics substantially diminish the potential of the voluntary standards approach.

A consensus approach would have to surmount congressional distrust of informal industry procedures for developing regulatory standards. In enacting auto emission standards in 1970 and fuel economy standards in 1975, Congress explicitly repudiated the alternative of "voluntary" approaches negotiated by industry under administration guidance. This background reinforces the intrinsic reluctance of a regulatory agency to "contract out" standard setting to private organizations, which are likely to overlook bureaucratic and political problems that the agency will face in implementing any measure that emerges.

262. With the exception of fuel economy, the improved social performance resulting from compliance with environmental, safety, and fuel economy standards does little to enhance consumer demand for the products of regulated firms, and the costs of compliance will surely reduce that demand. Even in the case of fuel economy, firms with low-mileage cars have no incentive to agree to voluntary standards. With limited exceptions in the field of automotive safety, there is no great threat of large damage judgments if voluntary standards are not adopted and observed.

263. The highly coucentrated automobile industry did propose an informal program of air pollution control and fuel economy to ward off mandatory standards, but Congress found their assurances inadequate.

agree voluntarily to ambitious technology-forcing measures involving large capital outlays and substantial risks.[264]

A more promising alternative is negotiated rulemaking. Under this approach, the agency would sponsor an informal process of exchange, negotiation, and consensus among interested parties to develop information, identify alternatives, and promote agreement on issues raised by a proposed agency rulemaking. The informal process would form the basis for a *Federal Register* notice of proposed rulemaking, followed by opportunity for comment and judicial review, as currently provided by the Administrative Procedure Act[265] and relevant organic statutes. The agency would retain ultimate authority to take action even if private parties disagreed; negotiation would not imply mandatory consensus but instead promote a process more informal and open and less dominated by litigation. It would also imply that agencies will enjoy more discretion and power.

Under present rulemaking procedures, presentation of data and analysis consists of formal submissions written or supervised by lawyers, whose incentives often will favor a one-sided presentation of technical and policy issues in order to lay the groundwork for later judicial challenge to an agency action. If adequate incentives for good-faith discussion can be provided, a topic discussed below, the process of negotiated rulemaking should encourage more candid and constructive input from the parties, which in turn could extend the agency's informational resources and promote realistic understanding of practical compliance burdens of given proposals. The process could further innovation by promoting the development of less burdensome and restrictive regulations with a sounder technical and operational basis.

Negotiated rulemaking could also reduce decisional costs and delays, which would encourage innovation. Informal discussion and negotiation could accelerate identification of the key issues and of the data and analysis required for their resolution. The present system often requires several rounds of formal comments or judicial remand for agency reconsideration of an issue that has been inadequately addressed. If a consensus process promotes agreement by all interested parties in the outcome, formal comment procedures could be substantially shortened and judicial review avoided altogether. If participants to the informal process could not agree, the agency could determine the proposed standard. Even in the latter situation, the informal process

264. A careful student of the consensus process has concluded that it tends to produce standards that reflect the "current state of the art," and that the voluntary-standards approach is not appropriate for regulatory programs that seek to force technology. *See* Hamilton, *supra* note 258, at 1450-51. *See also* Jackson, *supra* note 260.

265. *See* note 53 *supra*.

could help the agency frame a more workable and acceptable standard, diminishing the scope and complexity of the rulemaking proceedings and the likelihood of judicial review.

Negotiated rulemaking will most likely succeed with regulatory decisions that are neither so narrowly focused that they afford little opportunity for horsetrading and compromise, nor so open ended that they present an unmanageable number of issues and parties.[266] Much of the regulatory standard setting at issue here—effluent limitations, new source performance standards for particular industries, auto safety and emission standards—appears to fall comfortably within these extremes.[267]

Some negotiation and consensus already occurs within the existing rulemaking process. The responsible agency often consults interested parties before the notice of proposed rulemaking. In some instances—for example the rulemaking involved in *Home Box Office Inc. v. FCC*[268]—an active process of negotiation continues during the formal rulemaking proceedings and even after the period for submission of comments and argument. But a process of "on-the-record" submission predominates in major regulatory rulemaking proceedings: the use of such a process is, to some extent, attributable to procedural requirements imposed by law and the gauntlet of judicial review. Court decisions in cases such as *Home Box Office* and *Moss v. CAB*[269] have discouraged negotiation during rulemaking by forbidding, or at least casting doubt on, the legal validity of undisclosed off-the-record communications between interested outside parties once the formal com-

266. For example, a decision on the location of a major energy facility in a scenic wilderness area typically would not present any middle ground for compromise between project proponents and environmental opponents. At the other extreme, an action with broad ramifications, such as promulgation and implementation of an ambient standard for sulphates, might be unmanageable within the consensus mode.

Another limitation on the use of negotiated standard setting is the presence of large, divisive political controversies beyond the ability of the rulemaking agency to control. Controversies like those presented in the promulgation of new-source performance standards for coal-fired power plants or airbag standards will be decided in the White House or Congress. In such cases, the agency may have great difficulty promoting a negotiated consensus, because the agency cannot give binding effect to any agreement. Furthermore, aggrieved parties could outflank the agency decision process and present their claims elsewhere.

267. While command-and-control standard setting is the most obvious and promising context for developing a rulemaking process involving negotiation and consensus, the same type of process could be profitably employed with other regulatory tools. In a fee system, for example, the agency must establish emission-monitoring standards and perhaps the basic fee schedule as well. Under a transferable permit scheme, the conditions of transfer and monitoring standards must be set. These tasks require rulemaking that also deals with technical issues and controverted matters of policy; their accomplishment might accordingly be advanced by the proposed procedure.

268. 567 F.2d 9 (D.C. Cir.), *cert. denied*, 434 U.S. 829 (1977).

269. 430 F.2d 891 (D.C. Cir. 1970).

ment period has begun.[270] But agencies' hesitation over negotiation also reflects their frequent reluctance to "lose control" of the rulemaking process. This reluctance reflects agency staffs' ideological premise that the agency represents the public interest and that it would accordingly be an abdication of its responsibilities for the agency to turn standard setting over to a private negotiating process. In addition, agencies often take a firm, even extreme, position at the outset, expecting to be whittled down during the rulemaking process. If an agency endorses a compromise position at the outset, subsequent proceedings and the threat of judicial review may lead to further compromises in favor of regulated industry and substantially dilute the ultimate measure adopted. In addition, administrators wish to maintain flexibility to deal with shifting political pressures and bureaucratic exigencies. An agency may engage in consultation, but it usually prefers to keep the main lines of policy development and implementation to itself.[271]

Private parties may also be reluctant to engage in a process of open discussion and negotiation. If they can be harmed by delay or have limited resources, they may fear informal negotiation is a device to postpone decisions and wear them down by multiplying the number of proceedings in which they must participate. Also, good faith negotiation necessarily involves some disclosure of the parties' true positions and priorities. Such disclosure may compromise later assertions of more intransigent legal positions seeking to overturn the agency's decision on judicial review.[272]

Greater use of informal discussion, negotiation, and consensus is feasible only if the agency and interested private parties believe their interests lie in cooperation. If any major actor sees more gain to be had from adopting extreme positions or from delay or postponement of serious participation until formal proceedings are under way, the process will not work. The task is thus to identify the incentives that the vari-

270. However, these decisions have been implicitly or explicitly qualified or undermined by more recent decisions. *See* Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, 435 U.S. 519 (1978); Action for Children's Television v. FCC, 574 F.2d 458 (D.C. Cir. 1977). For discussion, see Note, *Due Process and Ex Parte Contracts in Formal Rulemaking*, 89 YALE L.J. 194 (1979).

271. *See* RFF and Urban Institute, *supra* note 136.

272. The formal adversary process can itself represent a form of bargaining, but of a peculiarly stilted sort. The agency often proposes regulations more stringent than those that it hopes to adopt. The parties respond by taking equally unrealistic positions, often advancing all factual, technical, and legal objections, whether or not they involve matters of deep concern to them. The agency may attempt to guess, by inference or hunch, those matters of deepest concern to the parties and specify a result that reasonably accommodates their interests and the agency's own objectives. But if its intuition fails, judicial review and a possible remand for further proceedings will follow. This is a process of negotiation and compromise through a legal version of blindman's bluff.

ous actors might have for engaging in a process of negotiated rulemaking and devise institutions that maximize those incentives.

The regulatory ageney's principal incentive is to expedite the rulemaking process by reducing the length and complexity of formal agency procedures and by avoiding judicial review and remand. If the regulations issued are broadly acceptable to interested groups, the process of implementing those regulations should also be simplified. The risks to the agency of a negotiated standards approach are loss of agency control over the outcome, further dilution of proposals in industry's favor, failure of consensus, and further delay.

The interests of regulated firms are more complex. In the case of regulation of existing products and processes, delay postpones compliance, which is a situation some firms will favor. In the case of new products or processes, firms will be reluctant to make substantial investments until regulatory requirements are clarified, which creates incentives to minimize delay and uncertainty. Negotiated rulemaking gives firms the opportunity to influence agency regulatory initiatives in favor of more "realistic" approaches involving less burdensome technical constraints or compliance outlays.

The position of environmental and consumer advocates is also complex. Formal procedures provide leverage for advocacy groups to develop their case and to build a record for judicial review through discovery or cross-examination. Yet these procedures are costly and public interest groups' resources are generally quite limited. If informal negotiation supplants formal procedures, the costs of participation will fall, but environmental and advocacy groups will lose some leverage. If informal negotiation simply adds a step to the existing process, these groups will fear dilution of their limited resources.

Three steps must be taken to strengthen the incentives for all parties to participate in good faith in a negotiation/consensus process. First, the opportunities for delay in the present system of agency procedures and judicial review must be substantially reduced as a quid pro quo for participation in a successful process of negotiation and consensus. Second, the responsible agency must be willing to run the risks involved in giving up a measure of control over the rulemaking process and invite an active role by outside parties in the earlier, more fluid stages of policy formation. Agencies may be willing to do so if existing procedural formalities and standards of judicial review are correspondingly relaxed. Third, to compensate advocacy groups for the relaxation of procedural formalities and to equip them to participate effectively in informal processes, funding for such participation should be provided.

The negotiated rulemaking proposal retains current rulemaking procedures and judicial review, acknowledging the need for formal, ex-

ternal checks on agency discretion. Formal procedures and judicial review, however, pose a serious danger. Parties may participate without good faith in the negotiated standard-setting process, reserving their adversary position for the formal stages of decisionmaking and using the negotiating stage simply to delay. Alternatively, parties, particularly those with limited resources, may refuse to participate in the negotiation process and save their resources for the formal stages.

To minimize these dangers, reviewing courts should take two steps. First, the existing "hard look" standard of judicial review and associated agency decisionmaking requirements[273] must be considerably relaxed where a representative process of negotiated standard setting has yielded a consensus position.[274] For example, the courts could accept less detailed agency explanations for decisions, including rebuttal of outside parties' criticisms; decline to require successive "rounds" of comment in response to new data or issues; relax requirements that agencies provide a comprehensive "record" of the data and analysis justifying the decision; and forego a detailed examination of the consistency of the agency's decision with such record. On the other hand, if the process does not yield concensus, courts should apply the "hard look" approach and associated procedural formalities to ensure effective review of agency decisions. Finally, courts should heavily discount claims that could have been raised during the negotiation stage. These steps would enhance incentives for participation in negotiated standard setting. The agency would gain from consensus but would be subject to "hard look" review if it failed to secure consensus. The agency's greater freedom from procedural formalities and judicial review would give it more discretionary power, alleviating its concern that negotiation would lead to a serious loss of control and allow private parties to dictate outcomes. Parties would have less opportunity to use formal procedures to delay or influence agency decisions and would have greater incentives to participate in the negotiation stage. These steps can be justified because a representative negotiating process resulting in a consensus position would provide safeguards functionally equivalent to those afforded by the existing "hard look" approach to judicial control. The reduced formalities retained would provide for sufficient judicial control of plain illegality.[275]

273. *See* S. BREYER & R. STEWART, *supra* note 52, at 291-309, 478-556.

274. The indicia of a good faith, representative process include stated agency policy to favor negotiated approaches, funding for those participants with limited resources, and agency willingness to give up a measure of control and seriously entertain interested parties' initiatives. In some respects these indicia are subtle, but not beyond the ken of discerning judges. Similar discernment is needed to distinguish cases where parties have sought to exploit the process by withholding their big adversary guns for the formal phase.

275. It might be argued that the quid pro quo approach accomplishes nothing because it relaxes procedural formalities and reduces the scope of judicial review only in instances where

Courts on their own initiative might take the steps suggested.[276] However, congressional legislation would help to encourage courts and agencies to promote negotiated rulemaking and eliminate legal uncertainties raised by decisions prohibiting "off the record" communications in notice and comment rulemaking. So far, these prohibitions have been applied to communications occurring after the notice-and-comment period had begun. However, some opinions indicate that the prohibition might apply to communications occurring before the notice of proposed rulemaking,[277] particularly if the content of subsequent proposals is substantially affected by such communications. In many cases, effective negotiation could hardly go on if agency representatives could not confer informally with some parties to the rulemaking process without including all affected parties. Even if all participating parties involved were present, publicity would dampen the possibility of vigorous negotiation.

Congress should explicitly validate the informal negotiated stan-

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those interested in a proposed rule reach agreement. But in such cases the quid pro quo is irrelevant because there will be no judicial review at all, and the rulemaking can be speedily accomplished. This argument overlooks, however, three substantial considerations.

First, agencies may not attempt a negotiated approach, fearing that nonparticipants could always successfully insist on a full panoply of procedural rights and judicial review. The quid pro quo greatly reduces this danger and reassures the agency of judicial acceptance of informal procedures.

Second, active promotion of negotiated rulemaking by lawyers and by executive branch authorities, such as the Office of Management and Budget or the current administration's Task Force on Regulatory Relief, would help wear down agency reluctance to engage in such negotiation. The quid pro quo would assist such promotion.

Third, the practical effect of a quid pro quo approach could be to enhance effective agency authority even in cases where full agreement was not reached by putting a greater burden on nonconsenting participants to persuade a court that the notice-and-comment procedures were deficient or that the result was arbitrary or capricious. The greater use of informal procedures and an open acknowledgment of their legitimacy could well lead, by small steps, to judicial encouragement of informal processes by cutting back on judicial relief at the behest of those who have insisted upon full notice-and-comment procedures and judicial review. Courts have in the past encouraged notice-and-comment rulemaking in lieu of formal adjudication or formal rulemaking by cutting back on the effective availability of procedures. *See* S. BREYER & R. STEWART, *supra* note 52, at 481-98. In light of emerging criticisms of the notice-and-comment rulemaking process, analogous judicial encouragement of informal negotiation might occur.

What is really at issue is a potential shift in the norms of agency decisionmaking and judicial review. The quid pro quo will not by itself accomplish such a change, but might well promote it.

276. In litigation concerning the National Environmental Policy Act, 42 U.S.C. §§ 4321-4361 (1976), courts have imposed a "discount" principle requiring, except in cases of plain illegality, that litigants challenging the adequacy of an environmental impact statement must have presented their claims in a concrete and focused fashion to the agency during preparation of the environmental impact statement. *See* Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, 435 U.S. 519 (1978). Another parallel is found in court decisions sustaining informal negotiations as an acceptable mode of regulatory decision when the hazards of formal procedures seemed especially severe. *See* Action for Children's Television v. FCC, 564 F.2d 458 (D.C. Cir. 1977).

277. Home Box Office, Inc. v. FCC, 567 F.2d 9 (D.C. Cir.), *cert. denied*, 434 U.S. 829 (1977). *See generally* Note, *supra* note 270.

dard-setting process. Since the parties to such informal negotiation would probably constitute an advisory committee under existing law, amendment of the Federal Advisory Committee Act to eliminate requirements of publicity would also be required.[278] Objections to nonpublic deliberation during the negotiating phase should be tempered by safeguards that the process be representative, and by the requirement that the results of the process be embodied in the notice of proposed rulemaking to serve as the basis for subsequent formal proceedings.[279]

An adequate and workable process of representation in negotiated standard setting has several requisites: a small number of participants, inclusion of important and relevant interests, and funding for participants with limited resources. As the number of parties to a negotiation increases, so do the difficulties of developing consensus within a reasonable time. Since regulatory standard setting affects many firms and individuals, the numbers of participants often might become unmanageable. In practice, the problem may not be so great. Effective participation will require resources and adequate background knowledge, factors that will substantially limit involvement by environmental or consumer advocacy groups. Recently, regulated firms have banded together in trade associations or special-purpose advocacy groups to present a joint industry position in rulemaking.[280] While conflicts of interest among firms might be more acute in negotiated standard setting because of the agency's greater flexibility in cutting deals, joint participation often would continue.[281]

278. 5 U.S.C. app. I (1976). *See* National Nutritional Foods Ass'n v. Califano, 603 F.2d 327 (2d Cir. 1979).

279. The various participants in negotiated standard setting should ensure the maintenance of a rather full and exact written account of the issues identified, the consensus reached, and the underlying considerations and data developed, in order to prevent evasion or distortion by opponents during the formal proceedings. Good recordkeeping, if existing "hard look" requirements are relaxed as proposed, should provide an adequate basis for courts to exercise their essential function of reviewing agency decisions for violations of constitutional or statutory authority.

Under present law, an agency initiates rulemaking with a notice containing the text of the proposed rule or describing its general subject, together with a statement of, or reference to, the considerations, data, and analysis that underlie the proposal. The recordkeeping requirement would provide a convenient mechanism for linking the negotiated and formal modes of the rulemaking process in negotiated standard setting and for alleviating concern by nonparticipants over "closed door" decisionmaking.

The safeguards described in the text should be adequate to meet claims that negotiated rulemaking under broad statutes represents an unconstitutional delegation of legislative power to private groups or that it offends due process. For discussion, see Note, *supra* note 251, at 1880-90.

280. Natural Resources Defense Council v. Costle, slip op. (S.D.N.Y., Feb. 4, 1980) (Chemical Manufacturer's Ass'n, intervenors); 9 ENVIR. REP. (BNA) 1277 (1978) (petition of Manufacturing Chemists Ass'n to hold public hearings on proposed EPA offset policy).

281. At times individual firms may insist on independent representation because of conflicts of interest within an industry. Several environmental and consumer advocacy groups may wish to participate, even though they lack the resources to do so fully, because they fear that they will be outflanked in the negotiation process and that subsequent formal proceedings will be "window

Theoretically, the baffling question of how the agency can ensure representative participation may be impossible to resolve.[282] Pragmatically, the answer is more straightforward. The negotiation process builds upon, and partially supplants, the existing rulemaking process. To avoid delays and judicial reversals, an agency will have to include in the negotiation stage representatives of all parties who could be expected to play a major role in the rulemaking process and credibly threaten to seek judicial review of an adverse decision. Some of these parties—particularly environmental and consumer advocacy groups and perhaps representatives of smaller firms—may be unwilling to participate in the informal process without funding support because of their limited resources. Funding is the price of avoiding boycott and subsequent subversion of the negotiations by groups who can plausibly justify to reviewing courts their refusal to participate in the negotiation stage. To enable the agency to effectively manage the entire rulemaking process, the agency should disburse the participation subsidies and enjoy substantial discretion in doing so.[283]

Agency participation in the negotiation process will involve delicate matters of judgment and timing. The agency cannot simply leave outside parties to negotiate a solution, because the prospects are too slim that the agency would endorse the result. On the other hand, the agency cannot seek to dictate the outcome or it will erase incentives for outside parties to participate in informal negotiation rather than challenge the agency's position in formal proceedings.[284]

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dressing." They also may be trying to obstruct. The agency must be prepared to insist that parties with common interests agree upon joint representation. Although it would have no legal authority to compel consolidation, its persuasive powers would stem from the greater substantive discretion it would enjoy under relaxed judicial review. However, a party that believed that it had been unfairly squeezed out of the negotiation process could present its claims in the formal stage of the proceedings and seek relief from the courts upon a convincing showing of substantial prejudice.

282. *See* Stewart, *The Reformation of American Administrative Law*, 88 HARV. L. REV. 1667, 1776-81 (1975).

283. The disbursing authority within the agency should not be the prosecuting or operating arm of agency staff, which may prefer groups supporting its position, but a branch (probably the general counsel's office) with a strong interest in avoiding delay and judicial reversal. This interest should move the responsible agency official to fund those who could most credibly threaten to boycott and subsequently undo the negotiated consensus. It also would provide a healthy check on any tendency to favor pro-agency groups. To promote a manageable negotiation process, the agency could condition funding on joint representation, as the Food and Drug Administration has apparently done for consumer liaison participants in the advisory committee context.

The agency authority responsible for disbursing funds need not narrow grant recipients to those limited-resource groups that can credibly threaten to subvert the negotiation process through subsequent formal proceedings. The agency should be free, subject to budget constraints, to provide funding to other advocacy groups or to underwrite advisory committees or other nonpartisan technical bodies. However, agencies would have less incentive to fund groups who would otherwise not play a large role in the proceedings and whose position is essentially the same as that of the agency's prosecuting staff, simply to buttress the agency's position on judicial review.

284. At least one instance of successful negotiated regulatory standard setting has been stud-

Given both the legal uncertainties regarding agencies' authority to provide funding in this novel context and political controversy over the practice, congressional authorization would be desirable. Two strong arguments for such authority should help to overcome current congressional antipathy to such funding. First, funding is probably necessary to secure substantial reductions in regulatory delays and decisional costs in a negotiation process. Second, the agency's incentives in providing funds in this context—to avoid subsequent judicial challenges by groups with limited resources—should check the tendency for preferential treatment of groups with views similar to the agency's.

Even if consensus is achieved, in whole or in part, during negotiations, it may break down in subsequent formal agency proceedings and litigation may follow. One of the parties to the consensus may repudiate it. Alternatively, a party that did not participate in the negotiation phase may enter the proceedings in the formal phase and attack the consensus proposal. The agency has no legally binding way of foreclosing such flanking maneuvers. It is doubtful whether a negotiated consent settlement precludes the parties from asserting a contrary position during subsequent rulemaking proceedings and judicial review. No legal constraint prevents firms and groups, including close allies or offshoots of the parties who do participate in the negotiation process, from sitting out the negotiation process and then entering the proceedings in the formal phase. It would be unwise and, in the absence of adequate safeguards, perhaps unconstitutional to adopt a collective bargaining model and use the principle of exclusive representation to empower the participants in an informal negotiation proceeding to bind all those affected by the outcome and deprive them of legal redress.[285] Agencies should instead rely on two other safeguards to

ied: the Exchange Network Facilities for Interstate Access Interim Settlement Agreement on tariffs, subject to Federal Communications Commission (FCC) regulatory authority, for use of Bell System facilities by firms offering competing interstate/intercity WATS/WTS-like services. The negotiations succeeded because all participants had a mutual interest in reducing uncertainty and delay (formal proceedings would have taken up to five years), and because the FCC, which had power to mandate by regulation what the private parties failed to achieve, took an active role in the negotiation process. No consumer advocacy group participated in the process. *See* K. Borchardt, The Exchange Network Facilities for Interstate Access (ENFIA) Interim Settlement Agreement (1979) (Harvard Program on Information Resources Policy Publication P-79-4). For a discussion of new approaches to negotiation, including new strategies of mediation, see R. FISHER, INTERNATIONAL MEDIATION: A WORKING GUIDE (draft ed. 1978).

285. Because many persons who did not participate in pre-rulemaking negotiation would have a legal right to participate in subsequent notice-and-comment proceedings and obtain judicial review of the outcome, efforts to cut off those rights by making participants the binding representatives of nonparticipants would raise due process issues. *See* Comment, *Due Process Rights of Participation in Administrative Rulemaking*, 63 CALIF. L. REV. 886 (1975). Some form of notice to nonparticipants, and a judicial review of the adequacy of their representation by nonparticipants, might be required. Compliance with these requirements could involve cumbersome delays that would gravely undermine the efficacy of the negotiation process.

counteract flanking attacks. First, incentives that lead parties to participate in the negotiation process should, in most cases, also lead them to adhere to a consensus. Second, courts should relax the "hard look" approach to judicial review where a consensus has emerged from the informed negotiation process and reject flanking efforts unless the agency has clearly exceeded its authority or acted capriciously.[286]

Broad-scale agency use of negotiated standard setting cannot be mandated. It must grow out of agencies' perception that the process will advance their self-interest by reducing decisional costs, delays, and court challenges and by promoting policies that are more easily implemented because they are more acceptable to the parties involved. But congressional legislation would help to remove inhibitions on negotiated standard setting by clarifying uncertainties in existing law and by signaling legislative encouragement. Specifically, such legislation should:

(1) Exempt consensus negotiation participants from the Federal Advisory Committee Act or encourage consensus negotiations under the Act, by providing expedited chartering and exemption from public deliberation requirements.

(2) Make clear that the *Home Box Office* prohibition against off-the-record communications does not apply to such negotiations.

(3) Authorize agency funding of negotiation for participants with limited resources.

(4) Provide that courts take negotiated standard-setting procedures into account by relaxing the scope of review where it has been successfully employed.[287]

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286. The agency itself remains legally free during the course of subsequent formal proceedings to repudiate or alter the negotiated consensus. Indeed it *should* do so if the formal proceedings show that the consensus is fundamentally flawed because it rests on mistaken premises or ignores vital considerations or interests. But the agency can afford to do so only occasionally and for demonstrable, unanticipated good cause. Otherwise, it might destroy the incentive of the private parties to participate in such a process in the future and undermine its own interest in the viability and credibility of negotiation. For this reason it should not use the consensus process for decisions so politically controversial that the agency cannot control the ultimate resolution. *See* note 266 *supra*.

287. Negotiation is already widely used in adjudication, where it faces fewer obstacles than in rulemaking. The parties to an adjudication are usually more limited and well defined. Adjudicatory proceedings need not be open to any member of the public who wishes to participate. These features make it feasible to negotiate and enter into settlement agreements among all the parties without fear that nonparticipants will outflank the agreement by attacking it in subsequent proceedings. The interests of nouparticipants are protected, to some degree, by judge-made opportunities for post-settlement intervention, which are sufficiently limited so that they do not seriously undermine the incentives of the parties to reach a negotiated solution. In contrast to rulemaking, a successfully negotiated compromise in adjudication will ordinarily supplant formal proceedings by excluding the availability of subsequent agency hearings or judicial review.

3. *Technical Advisory Committees and Research Institutes*

Because of limitations of budget, personnel, time, and working experience, regulators cannot hope to develop in-house all the information and specialized experience needed to make effective regulatory judgments in a timely fashion. The regulator and regulated industry are placed in an adversary relationship that hinders cooperative research to resolve the technical issues. Particularly in light of "hard look" judicial review, relevant knowledge and information are truly a form of power in this context. Industry is reluctant voluntarily to provide the data and analyses that would enable an agency to impose stringent and effective regulations, and an agency is likely to suspect the materials and views that regulated firms voluntarily choose to provide.

In addition, many regulated firms have lost respect for the integrity of the regulatory process.[288] In both rulemaking and formal adjudication, partisan presentations are filtered through procedures that tend to foreclose traditional scientific dialogue and concensus. Technical and scientific issues are resolved by a regulatory staff subject to political pressure and generally lacking in high standing in the scientific community. Its decisions are then reviewed by judges without technical qualifications. Related firms who believe that regulatory controls are the result of capricous, ad hoc, and largely unpredictable political considerations operate under a pervasive psychological climate of uncertainty and distrust that can seriously retard new investment. The availability of formal procedures for agency decisionmaking and of judicial review imposes some checks on the agency and the quality of its decisions but does not dissipate the climate of uncertainty and distrust.

A potential solution to this problem is the use of advisory committees to resolve disputed technical and scientific issues, particularly those involved in screening of particular products or in individual source permit disputes.[289] Advisory committees composed of experts not affili-

288. To some extent, lack of trust may be an unfortunate consequence of Congress' penchant for statutory provisions requiring regulatory decisions to be made solely on technical and scientific grounds. The reality is that relevant decisions cannot be made solely on such grounds. For example, the Clean Air Act provides that ambient air quality standards be set on the basis of threshold health effects, Clean Air Act § 109, 42 U.S.C. § 7411 (Supp. III 1979), when in reality no clear thresholds can be identified. In such situations, agencies inevitably must base decisions in part on other factors such as economic cost, social disruption, risk aversion, or distributional equity, but may feel precluded from discussing these factors in formal opinions. In short, Congress often legislates hypocrisy into agency decisions.

289. The regulatory agency can seek to meet its need for additional, accurate information and analysis in three other ways. First, it can use formal processes to compel the production of data and stimulate the submission of information and views from interested parties. This method is stilted and time-consuming. Second, the agency can hire outside contractors to prepare the additional information and analysis. This method is also time-consuming and expensive. The most

ated with the parties to the controversy could ensure more informed and accurate technical decisions, thereby promoting trust in the integrity of agency decisions. The authority of specialized knowledge, disciplined by peer review, would be substituted for formal procedures and judicial review as a means of legitimating agency authority. This may appear an ironic reversal of the traditional "expertise" rationale for deference to agency discretion, but it recognizes the present reality of limitations on agency resources and the problems in reliance upon formal procedures.

Advisory committees cannot be expected to gather extensive data, and prohibitions against partisan affiliation may lead to committees of academics without much practical experience. However, advisory committees have potential advantages over the agency's use of a consulting firm.[290] They are likely to present more diverse views and perspectives, affording protection against bias and the neglect of potentially useful insights. Because courts would be more reluctant to overturn judgments of qualified, nonpartisan experts, the delays involved in appeals of technical issues might be reduced.

The Food and Drug Administration (FDA) has made the most far-reaching and successful use of technical advisory committees. The FDA initially turned to advisory committees to carry out its statutory duty of removing inefficacious prescription drugs from the market.[291] The job could never have been accomplished through formal hearings. Advisory committees were also used to defuse charges that cumbersome agency review and approval practices were creating a "drug lag"

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knowledgeable contractors are likely to have gained their experience by working for the regulated industry and therefore be biased or give the appearance of bias. Finally, contractors' work product is generally subject to examination and rebuttal through the formal adversary process. Agency hiring of outside contractors is accordingly not a substitute for adversary litigation, but a preparation for it. A third alternative is the use of negotiated standard setting, already discussed. This alternative is more promising for standard setting than for decisions on individual products or projects.

290. *See* note 289 *supra*.

291. The 1962 amendments to the Food, Drug and Cosmetic Act for the first time required the Food and Drug Administration (FDA) to screen drugs for efficacy. 21 U.S.C. § 355(d)(5) (1976). *See* S. BREYER & R. STEWART, *supra* note 52, at 557-68. After years of effective paralysis in dealing with the problem, the FDA asked the National Academy of Sciences-National Research Council to form drug efficacy review panels composed almost entirely of well-recognized academic medical researchers and clinicians to perform this screening. The FDA then proceeded against those drugs that the panels deemed lacking adequate evidence of efficacy. In these proceedings, the FDA was largely able to avoid formal hearings by insisting that the manufacturer present proof of efficacy in a form that few existing drugs, even those judged efficacious by the panels, could satisfy. The courts mainly upheld this legally dubious procedure, *see* cases cited *id.* at 567 n.144, in part because the task Congress had given the agency could not be accomplished through conventional procedures, but also because the high caliber and nonpartisan character of the advisory committees provided an assurance of scientific integrity.

in the United States.[292] Such committees also carried out a review of thousands of over-the-counter drugs and biological agents. Initial membership consisted almost entirely of academic researchers and clinicians, but representatives of other branches of the medical community have since been added, together with nonvoting liaison representatives from industry and consumer advocate groups. Meetings of committees are now open, and a written explanation for committee recommendations is provided.

Advisory committees have provided the FDA with resources to carry out reviews that it could not have accomplished otherwise and may have deterred manufacturers from using formal hearing procedures to challenge particular determinations. Most advisory committee recommendations are adopted by the FDA as a basis for decision and they have never been overturned by a reviewing court. Obstacles to clearance of therapeutically useful new drugs have been diminished and the use of advisory committees appears to have increased manufacturer respect for the regulatory process.[293] On the other hand, formal hearings have traditionally played a minor role in most FDA decisionmaking, so that the FDA experience does not provide direct evidence that advisory committees would reduce the incidence of formal proceedings in other regulatory areas.

The FDA's use of advisory committees was based on several special factors. First, FDA was able to identify many qualified nonscientific and technical experts in the academic medical community who were persuaded to serve on advisory committees. Second, the FDA screens individual products through an evaluation of scientific and technical data submitted by manufacturers rather than data gathered by the agency. Third, FDA regulatory decisions are sufficiently discrete and focused to entrust initial resolution to part-time outside advisors.[294] Fourth, because of the breadth of its statutory authority and the unwillingness of courts to second-guess the FDA on public health questions, the FDA has great substantive policy discretion, a factor which helps to deter or defeat court challenges to committee recommendations accepted by the agency.

Technical advisory committees are most likely to succeed in situations with these four characteristics. The environmental regulatory

292. *See generally* L. Schifrin, Lessons from the Drug Lag Studies 48-56 (1980) (OTA Report).

293. For descriptions of the FDA advisory committee system, see Friedman, *Representation in Regulatory Decision Making: Scientific, Industrial, and Consumer Inputs to the FDA*, PUB. AD. REV., May/June 1978, at 205; Walters, *Use of FDA Advisory Committees: Present and Future*, 29 FOOD, DRUG & COSMETICS L.J. 348 (1974).

294. While recommendations of FDA advisory committees clearly involve policy issues, they are generally interstitial scientific and technical judgment.

context that most closely resembles the FDA situation is the screening of pesticides and individual chemicals. The parallel is not exact, because both the Federal Insecticide, Fungicide, and Rodenticide Act[295] and the Toxic Substances Control Act (TSCA)[296] mandate a more open-ended assessment of benefits and costs. Moreover, there may be insufficient numbers of qualified experts in the field of chemical regulation who would not be disqualified by partisan position or affiliation. However, EPA has apparently made no systematic effort to identify and recruit qualified individuals, although chemicals screening seems to present an important opportunity to use technical advisory committees. The present trial-type suspension and cancellation process in pesticide regulation is clumsy and time consuming. The implementation of TSCA has probably been undermined by the impossibility of accomplishing the task through formal proceedings. These problems are sufficiently close to those faced by the FDA to suggest a similar approach to regulation.[297]

The potential role for technical advisory committees in automotive and industrial air and water pollution control regulation appears much more modest.[298] Many of these regulatory decisions involve promulgation of general standards. The agency must accumulate large amounts of data, making it much more difficult to rely on part-time outsiders.

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295. *See* note 9 *supra*.

296. *Id.*

297. The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) provides explicitly for a scientific advisory panel to which the EPA must refer for comments and recommendations those decisions to initiate cancellation proceedings and to promulgate general FIFRA regulations. 7 U.S.C. § 136d(a) (1976). This provision might by implication preclude expanding the functions of the same advisory committee or creating a different advisory committee to make the initial determination whether to proceed against a pesticide or to propose initiatives through the adoption of regulations. Also, the EPA must be prepared to take legal risks in order to limit or foreclose the manufacturers' opportunity for a trial-type hearing to litigate technical issues. In the case of the Toxic Substances Control Act, *see* note 9 *supra*, basic policy decisions about implementation methods must be made before advisory committees can consider individual screening decisions.

298. Industrial air and water pollution regulation involves screening in specifying permit conditions for individual plants. If broad policy gnidelines are already in place, technical issues may play a major role in that determination. Examples include the engineering feasibility of a particular coutrol technology at a given site or the ecological effects of waiving otherwise applicable control requirements. The EPA has experimented with alternative decisional procedures in these coutexts to reduce the necessity for adversary hearings and enhance the quality of technical decisions. *See* Seacoast Anti-Pollution League v. Costle, 572 F.2d 872 (1st Cir.), *cert. denied*, 439 U.S. 824 (1978), *on remand*, 597 F.2d 306 (1st Cir. 1979). If adequate numbers of nonpartisan experts can be found, technical advisory committees could make a substantial contribution. However, the law is unclear whether the determinations of the advisory committee would be subject to adversary reexamination, including cross-examination of committee members, should an interested party insist upon it. Court decisions reviewing the EPA's waiver of thermal effluent guidelines for the Seabrook nuclear plant indicate that, in cases of adjudication subject to the trial-type hearing provisions of the Administrative Procedures Act, 5 U.S.C. § 554 (1976), advisory committee determinations must, at a minimum, be made available to the parties and subject to rebuttal evidence and argument. Cross-examination may be required as well. *Id.*

Moreover, issues of policy and administrative implementation typically play a far larger role in standard setting than in individual screening.[299]

Another potential obstacle to widespread use of advisory committees is the Federal Advisory Committee Act.[300] Under existing decisional precedent, reliance by an agency upon a group of outside experts to resolve scientific and technical issues as an integral part of regulatory decisionmaking would make the group an advisory committee subject to the Act.[301] The Act's requirement, with limited exceptions, of open deliberations was initially regarded by the FDA as an obstacle to the effective functioning of advisory committees, but the FDA committees apparently have accommodated themselves to the basic principle without serious difficulty. In addition, the Act, whose purpose in part is to limit the use of advisory committees, requires Office of Management and Budget clearance before a new committee may be established; this process is time consuming and approval is often grudging. An appropriate congressional declaration of policy favoring advisory committees in the regulatory process and providing for expedited "short form" clearance for creating committees could alleviate legal uncertainties and lessen inhibitions caused by the current system.[302]

Federal conflict-of-interest regulations also restrict the advisory committee alternative by disqualifying potential members. These restrictions appear to be overbroad and should be relaxed.[303] Finally, successful use of advisory committees will depend on support from the responsible agency, which must be persuaded that their use will enhance agency effectiveness.

A second alternative for improving technical decisionmaking is the

299. Advisory committees in standards setting are likely to make their greatest contribution in two situations. The first involves broad-based decisions in regulatory strategies with a substantial technical or scientific base, such as the EPA's strategy for dealing with long-distance sulfate pollution. Here, the agency should have the benefit of the best available technical judgment to ensure that decisions on major regulatory initiatives do not rest on faulty science or technical misunderstandings. Second, discrete technical issues may be identified in the midst of regulatory decisions on standards. Referral of such issues to an advisory committee might expedite the regulatory decision if the agency is willing to take the initiative in giving up close control over the process, and if the parties, because of concern over delay, limited resources, or other factors, will cooperate in such a step.

300. 5 U.S.C. app. I (1976).

301. *See* National Nutritional Foods Ass'n v. Califano, 603 F.2d 327 (2d Cir. 1979).

302. One alternative would be to formalize the resolution by outside experts of scientific and technical issues through an institution such as the proposed Science Court. This alternative should be rejected. A host of difficult and controversial issues concerning the composition and operation of such a body have not yet been resolved and may never be resolved. *See, e.g.*, A. Sofaer, The Science Court: Unscientific and Unsound 27-30 (1977) (Columbia Law School Center for Law and Economics Working Paper No. 1).

303. *See* R. Merill, Problems Involving Federal Conflict of Interest Restrictions on Members of FDA Advisory Committees and Agency Officials (1980) (Center for the Study of Drug Development, University of Rochester Medical Center, Publication Series 8032).

development of independent research institutes funded by contributions from the regulatory agency and regulated firms. Technical advisory committees are not suitable when large amounts of data must be gathered or basic research undertaken. Research institutes independent of regulatory agencies, industry, and private advocates could undertake these tasks. With the support and cooperation of all interested parties, these institutes could advance relevant technical learning through a nonadversary process, saving resources and time and promoting confidence in the technical basis of regulatory policy.

National laboratories conceivably could fill the research institute role. But they enjoy considerable bureaucratic autonomy, and in the past it has proven difficult to link their work to the research agendas of regulatory agencies such as EPA.[304] Another, more promising model for relating research to regulatory policy is provided by The Health Effects Institute recently established to study the impacts of automobile pollutants. Funded by EPA and industry at an eventual level of twelve to fifteen million dollars annually, the Institute is a nonprofit corporation headed by three independent trustees. It will rely primarily on contract research, drawing on scientific advisory committees for guidance and evaluation.[305]

Still other alternatives to formal advocacy as a means of resolving controverted technical issues exist.[306] As argued in the Conclusion, development of these alternatives is consonant with greater use of negotiated approaches to standard setting. By resolving key technical issues, these alternatives may promote negotiated agreement on remaining issues of policy.

C. Alternative Structures for Decisionmaking

1. Decentralized Regulatory Decisionmaking

Federal regulation is appropriate for products that are nationally

304. For a discussion of the problems in providing the needed scientific research for regulatory programs, see II NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL COMMITTEE ON ENVIRONMENTAL DECISIONMAKING, DECISIONMAKING IN THE ENVIRONMENTAL PROTECTION AGENCY 59-67 (1977).

305. The health bases for automotive pollution controls have been bitterly contested. 9 ENVIR. RPTR. (BNA) 1767-78, 1812-13, 1820 (1979) (controversy over revision of ozone standards). Evidently industry and the EPA both have concluded that there is more to be gained than lost by abandoning redundant research and an adversary posture in favor of a cooperative effort. If successful, the Institute would establish a precedent of potentially wide applicability. As yet, unresolved problems remain, however: assurance of high professional quality personnel for such an institute, the relationship between an institute's work and that of the regulatory agency staff and existing government research institutes, and the extent to which its work and personnel will be subject to examination and challenge in subsequent formal regulatory proceedings.

306. *See, e.g.*, M. WESSEL, SCIENCE AND CONSCIENCE 141-83 (1980) (ad hoc "consensus conference" of technical experts to resolve controverted issues).

marketed or where centralized decisions offer significant scale economies. These factors justify regulation of motor vehicles and chemicals on a more or less geographically uniform basis.[307] However, for industrial pollution, the arguments for centralization are far less weighty. Local and regional areas vary widely in the nature and severity of pollution problems and in their appropriate solution; pollution control regulation, particularly of new sources, trenches heavily on industrial development and land use decisions that have long been thought a local or state prerogative.

Federal pollution control legislation during the past decade has centralized control measures in Washington and has favored uniform solutions. Reversal of this trend could result in regulations more responsive to local variations in costs and benefits, thereby reducing compliance outlays and removing restrictions on industrial development in areas favoring growth. Stripping away layers of centralized review also could cut back decisional costs, delays, and uncertainties. Decentralization is likely to promote informal accommodation, partly because of limited opportunities for appeal. These developments should have positive impacts on market innovation. On the other hand, decentralizing decisionmaking could create more obstacles to new plant development in localities opposed to further development.[308]

The most serious objections to decentralization stem from the concerns underlying the present system. The prior system of decentralized control is widely blamed for creating unacceptably high levels of pollution; centralization has been viewed as a key to ensuring reliable control over industrial conduct.[309] Other considerations justify a substantial federal role. Some effects, such as sulfate pollution, spill over state boundaries on a broad scale.[310] Decentralization might

307. This generalization does not exclude some geographic flexibility, such as a "two car" strategy in motor vehicle emissions control, or the desirability of local experimentation on alternatives such as integrated pest management.

308. Such localities, however, already enjoy substantial veto powers under existing law. Concern over local veto or obstruction of new facilities was reflected in proposals for an Energy Mobilization Board to establish a central clearance process, including deadlines, for local, state, and federal regulatory decisions on energy projects. *See* Note, *The Energy Mobilization Board*, 8 ECOLOGY L.Q. 727, 727 (1980).

309. *See* Stewart, *supra* note 43. It does not follow, however, that a measure of decentralization now, following widespread recognition of the seriousness of pollution problems and the necessity of vigorous government action to meet them, would result in seriously inadequate controls. But a powerful sentiment holds that a substantial relaxation of federal direction and control would inevitably mean a serious deterioration in environmental quality, and that flexibility, which promotes efficiency and which is the chief virtue of decentralization, inevitably means laxity.

310. However, federal regulation thus far has largely failed to deal with spillover problems. *See, e.g.*, Wetstone, *Air Pollution Control Laws in North America and the Problem of Acid Rain and Snow*, 10 ENVIR. L. REP. 50001 (1980). For air pollution, this failure is explained partly by the focus of the Clean Air Act, which sets up a process for maintaining local air quality through state implementation plans.

mean relatively unrestrained development in some states that could threaten national interests in scenic and wilderness values.[311]

The principal regulatory strategies under current law—federal ambient standards or uniform technology-based effluent or emission limitations—sacrifice decentralized decisionmaking and local flexibility to national objectives. The challenge is to devise alternatives that promote decentralization and flexibility while assuring national goals. Basin-wide transferable pollution permit schemes are one candidate. If the total number of permits granted was established in accordance with federal objectives, their allocation—whether through regulation, market-based systems, or a combination thereof—could be left largely to state and local authorities, thereby minimizing centralized review of individual sources and promoting local flexibility. The approach has many unresolved problems.[312] Nonetheless, a transferable permit system seems better suited than existing command-and-control approaches to mediating competing considerations of federalism.

2. *Regulatory Budget and Sectoral Strategies*

Several measures could counteract the cumulative burdens and constraints imposed under the existing system by overlapping, uncoordinated regulatory regimes.

Adoption of an accounting system to inventory and tally such burdens and constraints is probably a necessary first step. One such accounting system is the proposed regulatory budget, which would measure the compliance outlays required by regulations and preclude an agency from imposing regulations whose compliance outlays exceeded a congressionally specified threshold.[313] This new system could promote review and control of aggregate regulatory impacts on the economy.[314] It could also facilitate assessment of the impact on particular industries, paving the way for sector-by-sector adjustment of regulatory requirements and a form of sectoral planning.

If adoption of a regulatory budget strategy would reduce compliance outlays, market innovation would benefit because of reduced diversion of resources. However, many of the adverse impacts of

311. Terziev, *PSD: New Regulations and Old Problems*, 5 HARV. ENVT'L REV. 130 (1981).

312. *See* text accompanying notes 235-46 *supra*.

313. *See* DeMuth, *supra* note 254, at 26.

314. The premise of the regulatory budget is that compliance cost outlays incurred by regulated firms are government expenditures for public purposes and that such outlays ought to be subject to the same form of legislative and executive branch control as regular budget outlays and tax expenditures. The impetus for the proposal is a growing concern over the amount of regulatory compliance outlays, the perception that regulatory agencies give relatively little consideration to such costs, and the belief that this deficiency cannot be adequately corrected by requiring cost-benefit analysis or internal executive branch review of particular decisions.

regulation on market innovation would not be captured by the regulatory budget. These impacts might well increase if a regulatory budget were adopted.

Practical considerations limit the types of regulatory costs and burdens that can be reasonably approximated and included in the regulatory budget.[315] The most easily measured impacts, and the ones that would accordingly loom largest in the regulatory budget, are compliance outlays. Even here, there are substantial difficulties in measurement.[316] The opportunity costs imposed by technical constraints, delay, and uncertainty could not, as a practical matter, be measured at all. Exclusion of these impacts would substantially understate the costs of regulation. Worse, the exclusion could encourage regulatory agencies to adopt forms of regulation, such as elaborate and time-consuming clearance procedures or highly restrictive technical constraints, whose impacts were not captured in the regulatory budget. Further, the agencies might avoid other forms of regulation (such as technology-based standards requiring installation of pollution control equipment) whose costs would be captured in the budget. This shift could well increase adverse impacts on market innovation.

Social innovation might also suffer because the benefits associated with improved social performance would not be counted in the budget. This circumstance could create a bias against forms of government intervention such as emission fees that resulted in higher measured compliance outlays but that also secured large gains in social innovation. The fee example is particularly telling, for many measured "costs" of such a system—fee payments to the government—are not an economic cost at all, but simply a transfer payment. For these reasons, adoption of a regulatory budget based solely on compliance outlays is not justified on the basis of innovation concerns.

A sound regulatory budget system would facilitate sectoral planning by permitting consistent sector-by-sector analysis of regulatory impacts. The most ambitious form of sectoral planning would be comprehensive industry-by-industry coordination of all regulatory policies

315. *See* DeMuth, *supra* note 254, at 26.

316. For example, where pollution reduction is achieved through process changes that also lower production costs, how much of the capital cost of the new process should be allocated to pollution control? Should the costs of retooling to manufacture autos with improved fuel economy be attributed to regulation or to consumer demands triggered by higher gasoline prices? Estimating compliance costs in advance, which a regulatory budget requires, is complicated by the fact that the prospect of large compliance costs encourages innovations that reduce such costs. Government and industry predictions of the compliance costs associated with particular regulations have often been far off the mark. *See* Comparisons, *supra* note 197, at 4-7. Decisional costs also could be included in the regulatory budget, although measuring the opportunity costs associated with lengthy involvement by top corporate officials in regulatory imbroglios would be difficult.

and other relevant government measures (tax policy, trade measures, industrial location applicable to each industry) in accordance with a plan for the future role and development of each industry in the national economy. Some commentators believe that Japan's adoption of elements of sectoral planning has played an important role in her recent industrial growth, and they urge that the United States follow an analogous approach.[317]

A system of sectoral planning would respond to claims that some industries carry disproportionate regulatory burdens and that regulatory policy must be coordinated with other government policies relating to capital formation and investment in order to revitalize ailing industries or stimulate new ones. However, this approach would involve a pervasive centralized control over sectors of the economy. Such control may be politically unacceptable and could pose serious problems in implementation.[318] A more modest approach would establish an institutional capability within the executive branch to monitor the cumulative impacts of regulation on particular industries and to modify on an ad hoc basis, with the specific approval of the President, regulations in especially severe cases or to arrange a least-cost reallocation of regulatory requirements.[319] Congress, however, probably would be opposed to granting any such open-ended authority.

A still more modest initial step would seem feasible and desirable. First, a body similar to the Regulatory Analysis Review Group in the Carter Administration or the Task Force on Regulatory Relief in the Reagan Administration should be charged with monitoring aggregate compliance outlays and other cumulative impacts of regulation preparatory to development of a regulatory budget. Second, the same body could lead the coordination of the provisions in existing statutes that allow one regulatory agency to consider the impacts of its decisions on

317. *See, e.g.*, J. Gresser, High Technology and Japanese Industrial Policy: A Strategy for U.S. Policymakers (1980) (Print of House Ways and Means Subcommittee on Trade). For a discussion of some problems and limitations of sectoral planning, see Scott, *How Practical is National Economic Planning?*, HARV. BUS. REV., Mar./Apr. 1978, at 131.

318. The logic of such a strategy implies industry-by-industry budgeting of regulatory requirements, balancing on a comparative basis the costs, including market innovation costs, of compliance and decisional burdens with the benefits of improved social performance. The relevant decisionmaker would aim for a cost-effective allocation of regulatory burdens. Because of the potential importance of cumulative or synergistic regulatory impacts, the decisionmaker would require authority to coordinate all major regulatory requirements impinging upon the market or social performance of a given industry. Shutdown or foreign trade constraints would be included in the determination, as would the use of alternative levers over firm performance, including direct control of firm investment or use of subsidies. Regulatory controls commit societal resources to the achievement of improved social performance. In many instances a more cost-effective system would expend those resources through subsidy schemes. Such are the ultimate implications of the "regulatory budget" concept.

319. *See* Note, *Delegation and Regulatory Reform: Letting the President Change the Rules*, 89 YALE L.J. 561 (1980).

the regulatory programs of other agencies (*e.g.*, motor vehicle fuel economy/air pollution trade-offs) and to recommend, if warranted, a congressional grant of presidential override authority of the sort previously discussed.

The basic premise of the regulatory budget and of related "planning" proposals is that our current regulatory system, far from being excessively centralized, is not centralized enough. The goal of central accounting and direction appears inconsistent with decentralizing strategies, including emission fees, transferable permits, and delegation of regulatory authority to state and local officials. The degree of conflict or compatibility between these two sets of approaches is explored further in Part V.

V

RECOMMENDED CHANGES IN THE REGULATORY PROCESS

A. Links Between Regulatory Tools and Decisional Processes

Command-and-control regulation requires government officials to make many engineering and economic judgments regarding the "availability" of control technologies and the feasibility of regulatory requirements. Those judgments have significant economic and social consequences. Given the seeming weakness of other incentives for technically sound decisionmaking by regulatory agency staff and our historic reliance on the courts to control administrative power, development of "paper hearing" procedures in administrative rulemaking and of a "hard look" standard of review seems in retrospect inevitable. Earlier sections have described the adverse effects of this system of regulatory tools and procedures on innovation.

Because of the interplay between tools and decisional processes, incremental modifications of either alone may do little to ameliorate innovation impacts. For example, a system that authorizes waiver of regulatory requirements for innovative technologies is likely to accomplish little if a firm must run the gauntlet of a procedurally demanding review process to obtain a waiver. On the other hand, more basic changes in regulatory tools and strategies may imply significant changes in decisional procedures as well. The interaction of these changes may generate positive effects on market or social innovation. For example, a "tier" approach of standardized tests for screening individual pesticides or other chemicals would require less testing of chemicals with low-volume uses. This approach would reduce reporting, review, and other decisional costs as well as compliance outlays. It might involve some sacrifice of social goals, such as "loss of control," in forgoing extra protection against risk. But in assessing the benefits of such an approach from the viewpoint of market innovation, reductions

in decisional costs and delays should be counted along with reductions in testing outlays.

Substituting other government tools for command-and-control regulation could secure even greater reductions in decisional costs. For example, a broad-based fee system assessing a charge against all major sources of a pollutant would greatly simplify the issues for administrative determination; the principal question would be the extent of a particular source's emissions. By contrast, a regulatory approach almost inevitably involves establishing different standards for each industry or industry subcategory, as well as hand-tailored specification of permit conditions for each source. Particularly for new sources, these processes involve substantial uncertainty and delay.[320]

Similar procedural benefits could be achieved under a transferable permit system. A permit system would rely on market transactions to make decisions about resource allocation, rather than on coercive controls imposed by administrators to determine resource allocation on a case-by-case basis. Such market transactions normally would not call for formal decisional procedures or judicial review. Nor would traditional procedural requirements apply to "market maker" activities by government agencies that intervened with purchases and sales to stabilize and smooth the operation of the permit market.

Government expenditure of public funds through subsidy programs, procurement contracts, or direct government research and development has traditionally been far less subject to procedural formalities and judicial review than command-and-control regulation. Conceptually, it is said that the government is acting in a "proprietary" rather than a "governmental" role. Functionally, the distinction recognizes that when the government is spending public monies rather than regulating, there is a stronger justification for discretion and speed in order to retain operational flexibility and to protect the public fisc, and a less compelling need for protection of adversely affected private parties. Accordingly, promotion of market or social innovation through these approaches also would reduce decisional costs, delay, and uncertainty.[321]

320. The simplification that would be achieved under an alternative such as a fee system should not be overstated. Variations in fee schedules among varions industries and provision for individual source "hardship" exemptions might be an inevitable feature of a fee system. Monitoring requirements would involve standard setting or screening decisions involving complex technical issues. The general level of fees would have to be adjusted periodically and in many instances a fee approach might be acceptable only if it were added "on top" of an existing regulatory base. Nonetheless, adoption of a fee approach should substantially reduce decisional costs.

321. This conclusion, however, requires two qualifications. First, as the previous analysis indicates, the case for government subsidies may in many contexts be too weak to make the benefits of reduced decisional costs a deciding factor that would tip the balance in favor of such subsidies. Second, the fact that our adversary legal system, for perhaps justifiable reasons, does not apply

B. An Agenda for Change

Congress and administrators have paid little attention to innovation in creating and implementing the current system of health, safety, and environmental regulation. This neglect is entirely understandable. In the case of market innovation, the adverse effects of regulation consist in large part of invisible opportunity costs, which have not been a high-priority concern of Congress and regulatory agencies. Instead, during the past fifteen years, they have focused on immediate reversal of deteriorating social performance by the industries subjected to regulation. Only recently has declining U.S. market productivity become a matter of widespread concern. In the case of social innovation, Congress' overriding goal has been to change regulated firms' conduct as quickly as possible in order to improve social performance. Command-and-control regulation was the tool best suited to the task. To achieve immediate improvements in social performance, Congress has sought to mandate diffusion of "available" control technology and to restrict new products and processes to those with acceptable social performance characteristics. Regulatory agencies instructed to implement these regulatory programs naturally adopted this same goal and strategy.

Command-and-control regulation has failed to provide strong incentives for the development of socially superior products and processes over the long run—a matter of less concern to Congress and administrators than shortrun behavior modification. Precisely because it is designed to mandate changes in individual behavior to further regulatory goals, command-and-control regulation also imposes costs, constraints, delays, and uncertainties that discourage market innovation.

Decisional processes reflect distrust by Congress and courts of regulated firms and administrators. More formal decisionmaking procedures and expanded access to courts have been developed to control agency discretion, expose agencies' resolution of technical issues to adversary testing, limit the perceived danger of agency slack or "capture" by regulated firms, and prevent agencies from imposing controls that threaten excessive disruption or cost. The delay, cost, and uncertainty associated with these procedures have thwarted innovation. Moreover, such procedures are sometimes ineffective at generating the technical information and judgment needed to resolve engineering and economic questions that pervade implementation of the current system of com-

with full force to expenditure by government of public funds does not obviate the need for "quality control" assurances. Experience with the municipal waste treatment program suggests that some form of input and review may be needed over expenditure programs to provide such assurances.

mand-and-control regulation. The result is an increased likelihood of regulation with technical constraints that frustrate and limit innovation.

Regulatory burdens other than shutdowns are starting to attract widespread attention. Although regulation has not been the principal cause of the slowdown in market-measured productivity growth, it inevitably has diverted some economic resources away from investment in the market sector in order to meet nonmarket social objectives. Evidence suggests that compliance outlays have contributed to between five and twelve percent of the productivity slowdown in the United States. The impact on productivity of delay, uncertainty, and technical constraints is unknown, but it could be significant. Such impacts must be weighed against the benefits of regulations, which are not adequately reflected in productivity measures.

Substantial steps could be taken to minimize the adverse effects of regulation on market innovation without weakening regulatory stringency. Often, the same measures also would promote needed social innovation. Four such step are: (1) promoting greater consideration of innovation impacts within the existing system of regulatory tools and adversary decisional processes; (2) modifying command-and-control tools to promote innovation; (3) greater use of advisory committees, negotiated standard setting, and independent research institutes to promote a cooperative approach to resolving technical and policy questions; and (4) substituting decentralized economic incentives for command-and-control regulation.

These strategies are the most promising of the alternatives discussed in Part IV. Alternatives 1 and 2 are politically more feasible, involving only moderate changes in the current system, but they also promise less progress is promoting market and social innovation. Alternatives 3 and 4, while promising more innovation, would involve substantial changes in the present system and to some extent undermine the assurance of effective enforcement. The time is ripe, however, for reassessment of the existing strategy of short term behavior modification through command-and-control regulation. The command-and-control approach is understandable as a "first generation" strategy for dealing with health, safety, and environmental problems. It is a high visibility response to demands for improved social performance. It persuades regulated firms that government is "serious" about social performance and about changing firms' conduct. It ensures the adoption of available measures known to improve performances. But this first generation "enforcement and diffusion" strategy has important limitations in the longer run. It involves high compliance costs and substantial disincentives to market innovation. In addition, the delays,

uncertainties, and costs associated with adversary decisional procedures are contributing in no small part to a powerful antiregulation mood in the nation. Unless the existing system is modified to ameliorate the impacts on innovation, society may sacrifice social performance by simply reducing stringency.

The capacity of the present approach to improve social performance also seems to be diminishing. The most obvious environmentally hazardous and persistent chemical pesticides have been removed from the market. Technological transformation appears close to exhausting most of the obvious routes to improved pollution control. In many sectors, "available" capital-intensive control technology is already in place or being installed. In the future, improving or even maintaining social performance in the face of continued economic growth will require more effective incentives for the development of environmentally superior farming methods and industrial processes and products.

The country now needs a second generation regulatory strategy that builds on the achievements and avoids the limitations of the first generation strategy. The second generation strategy should give more weight to dynamic considerations, recognizing the interdependence of social and market innovation and selecting regulatory schemes that promote both. The alternatives discussed below reflect ascending degrees of ambition in setting out a second generation regulatory strategy.

1. Promoting Consideration of Innovation Impacts within the Existing Regulatory System

A second generation strategy should first encourage greater attention by regulatory agencies and other administrative and executive branch authorities to impacts on innovation through study and analysis by line regulatory agencies and by advisory and review agencies such as the Council on Environmental Quality, Office of Management and Budget, and the Task Force on Regulatory Relief. These bodies already carry out extensive regulatory analysis directed primarily at compliance costs and at employment effects.[322] Their research responsibilities should be expanded to include impacts on market and on social innovation.[323]

322. *See* DeMuth, *supra* note 254, at 15-20.

323. Current regulatory reform proposals in Congress significantly codify and extend existing economic regulatory analysis. Innovation impacts are not explicitly included within the analysis required under these proposals. While the language of the proposals is usually sufficiently general to include innovation impacts, the proposed measures are principally directed at compliance costs, employment effects, and other potential dislocations. For example, the regulators analysis required by S. 262, 96th Cong., 1st Sess. §§ 601, 623 (1979), must include "a detailed analysis of the projected economic effects, including costs and economic benefits" of "major rules," defined as those having an annual effect on the economy of $100,000,000 or more, or causing "a significant change in costs or prices," or having a significant impact on employment or the competitive pro-

Analysis of innovation impacts should not be enforced through external mechanisms of judicial review. The adversary process in administrative decisionmaking and review is already overloaded. Interjecting difficult and elusive innovation issues into that process would increase cost and delay and thereby have an adverse effect on innovation. Judicially enforced "innovation impact statements" should therefore be avoided. Internal review of innovation analysis—limited to a relatively small number of problems annually—by executive and administrative bodies such as the Task Force on Regulatory Relief and by Congress is far preferable. The gains to innovation offered by this alternative would likely be modest and not without cost.[324] Nevertheless, promoting regulatory agency consideration of innovation effects is a worthwhile step that should be adopted.

2. *Modifications of Command-and-Control Regulation*

A somewhat more ambitious approach to promoting innovation would be to retain the framework of command-and-control regulatory tools but to modify elements of constraint, cost, delay, and uncertainty that adversely affect innovation. Regulatory agencies can pursue some of these opportunities within existing legislation while others would require piecemeal congressional modification of existing statutes.

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cess, or otherwise have "a major impact." Explicit inclusion of innovation impacts, including invisible opportunity costs, would be desirable, although efforts to quantify such impacts would be hazardous. Such a step is justified on two grounds. First, little is known about the impact of regulation on innovation. Government efforts to study those impacts will advance knowledge in part by stimulating similar studies in the private sector, providing a firmer foundation for future decisions on regulatory policy. Studying the relationship between regulatory measures, social innovation, and bottom line measures of social performance should be a priority. *See* Moesteller, *Innovation and Evaluation*, 211 SCIENCE 881 (1981). Second, study and analysis of innovation impacts by regulatory authorities, particularly if required by congressional legislation, will tend to promote greater consideration of innovation impacts in administrative decisions and strategies. In requiring agencies to analyze the impacts of regulatory requirements, the congressional sponsors of regulatory reform proposals have wisely excluded judicial review as a method for determining and enforcing compliance with such requirements. *See* S. 262, 96th Cong., 1st Sess. § 629b (1979). While the "regulatory analysis" required by the proposed legislation would be included in the record for judicial review of agency compliance with other statuory requirements, courts would not review compliance with the requirements of S. 262.

324. Studies and analysis consume time and other resources. Unless Congress signals more decisively a shift in agency priorities, agencies are likely to continue to neglect innovation impacts. *See* Sax, *The (Unhappy) Truth About NEPA*, 26 OKLA. L. REV. 239 (1973). However, the impact of general directives that regulatory agencies cousider innovation impacts would be enhanced if other bodies, such as the Council on Environmental Quality, the Office of Management and Budget, the Department of Commerce, or congressional oversight committees assumed the role of innovation champions. Such bodies would, however, review only a small percentage of regulatory proposals in the depth necessary to present a persuasive case for alternatives. *See* DeMuth, *supra* note 254.

a. Reducing Costs Associated with Chemical Screening

Case-by-case screening of pesticides and other chemicals tends to involve substantial uncertainty, delay, and high decisional costs. These burdens threaten to fall more heavily on new products, thereby inhibiting market innovation and, probably, social innovation. Such burdens might be reduced by moving towards a standards approach through use of generic testing protocols and development of a tier system specifying testing requirements correlated to volume, extent and mechanism of human and environmental exposure, and chemical structure and activity.

This system would involve the risks of allowing hazardous chemicals to slip by and of discouraging innovation by constraining technological development. Variations in the characteristics of individual chemicals would in any event limit the scope of a standards approach. Nonetheless, a move in the direction of greater standardization of testing requirements and screening criteria could promote innovation if Congress and administrative agencies were willing to impose less than the full battery of potential testing requirements.

b. Reducing Regulatory Burdens on Small Chemical Firms and Small-Volume Uses

Studies indicate that small firms play an important role in innovation by developing new products and processes that initially fill a small-volume "niche" but eventually play a major role in the industry after they are adopted by larger firms.[325] The present system of pesticides screening, by applying essentially the same requirements to all products, imposes a disproportionate burden on small firms and small-volume products, which probably has an adverse impact on innovation.[326] If a "tier" approach is adopted, it should expressly lessen the burdens on small firms and small-volume products to encourage market and social innovation.

c. Adjusting Regulatory Burdens and Reducing Delay and Uncertainty for New Industrial Sources

The current tendency to "load" regulatory burdens on new sources, particularly in air pollution regulation, coupled with the uncertainties and delays of case-by-case new-source screening, discourages investment in new plants. This, in turn, adversely affects market innovation and the social innovation associated with turnover in the capital

325. *See* TECHNOLOGICAL INNOVATION, *supra* note 71.

326. The Toxic Substances Control Act, *see* note 9 *supra*, may have a similar impact when fully implemented.

base. Two modifications of the current system could reduce those impacts. First, EPA could be directed to consider explicitly the balance of abatement burdens among existing and new sources and the consequent effect on the turnover of the capital stock and social innovation in setting new source pollution standards. This move would at least direct attention to a neglected issue and encourage a reduction in counterproductive new-source burdens.

Second, predictability and speed in new-source review could be promoted in nonattainment areas by standardizing trade-off ratios, the categories of emissions to be counted against a project, and other issues now decided through case-by-case screening. The review process also could be simplified for prevention of significant deterioration areas, particularly outside of environmentally sensitive Class I areas.[327]

d. Reducing Technical Constraints for Industrial Sources

Enforcement considerations have led regulatory agencies to base pollution control standards upon specific control technologies. New research and development efforts and changed agency priorities should promote development of monitoring and enforcement capabilities to police actual emissions. This capacity would allow greater flexibility in regulatory requirements and their implementation that in turn would reduce technical constraints and promote innovation. This shift in congressional and EPA priorities is needed in any event to ensure that the control technologies already installed are properly operated and maintained.

e. Reducing Technical Constraints on Automobile Performance

Adoption of a fleet-wide average measure for automotive air pollution performance would ease the technical constraints imposed by the present system and allow manufacturers greater flexibility, thereby encouraging market and social innovation. If adoption of average measures were combined with more ambitious research and development funding, it could support the development of a much broader domestic manufacturer portfolio of engine technologies and control devices. The adoption of a fleet-wide average measure for fuel economy performance and the gradual shift towards greater flexibility in auto emission regulation indicate the fleet-wide average approach could be politically and administratively feasible, although a "smoke burner tax" on especially high-polluting models might be politically necessary.

These changes would promote innovation by ameliorating particu-

327. For discussion of the problems generated by the present screening process and potential modifications, see NATIONAL COMMISSION ON AIR QUALITY, TO BREATHE CLEAN AIR, 2.1-29 to 2.14-43; 2.2-12 to 2.2-15; 3.5-1 to 3.5-92 (1981); Terziev, *supra* note 311.

lar elements of the existing regulatory system. However, the inherent tendency of command-and-control regulation to impose technical constraints and high compliance costs would remain. Government agencies still would have to decide a multitude of disputed engineering and economic issues. The chronic difficulty of providing adequate demand for development of new, environmentally superior products and processes would persist.

3. Decisionmaking Alternatives to Formal Advocacy

Alternatives to formal decisionmaking procedures hold promise for reducing decisional costs and delays, providing regulatory decisions with a more informed and sounder technical basis, and promoting confidence in the regulatory process. These alternatives include negotiated development of standards in rulemaking and greater use of technical advisory committees and of outside institutes that could generate data and analysis on complex and pervasive technical issues whose resolution exceeds the capacity of the advisory committee system.

The notion that such "process" changes would provide major innovation benefits should be assessed with a healthy skepticism. But these changes could improve the capacity of the command-and-control regulatory system to deal with technical, scientific, and engineering issues and enhance confidence among regulated firms in that system.

The development and use of outside institutes would probably require congressional funding on a case-by-case basis. Greater use of technical advisory committees could be encouraged by amending the Federal Advisory Committee Act (FACA)[328] to provide for mandatory Office of Management and Budget approval of such committees, provided they meet criteria similar to those applicable to FDA committees and by relaxing conflict-of-interest regulations.[329] Funding should be provided for liaison members from industry and environmental or consumer advocacy groups.

A provision should be added to the Administrative Procedure Act[330] specifically authorizing agencies to use negotiation as part of rulemaking procedures. Further, it should direct courts reviewing rulemaking procedures to consider the opportunities of parties to participate in such negotiations and the desirability of promoting, subject

328. 5 U.S.C. app. I (1976).

329. 21 U.S.C. § 360c(b)-360c(d) (1976). The legislative history should make clear that the Administrative Procedure Act does not preclude reliance by agencies on advisory committee recommendations and analysis, nor require discovery directed against advisory committee members, so long as the results and basis of advisory committee determinations are publicly available in written form and are not relied upon by the agency to resolve a centrally disputed factual issue in a formal adjudicatory proceeding.

330. *See* note 53 *supra*.

to principles of fair access, more informal methods of decision. The FACA should be amended to make clear that such negotiating groups are not "advisory committees" subject to FACA requirements. Agency funding for participants in the negotiations process should be authorized.[331]

The current mechanism for legitimating the exercise of agency discretion is the opportunity for formal advocacy and judicial review. Legitimacy is conferred by negotiation through agreement of the affected parties, and by bodies of experts through the authority of knowledge. Reliance on negotiation and on bodies of outside experts may often be complementary. The pronouncements of experts may, because of their authority and impartiality, be accepted by the parties as a basis for agreement on issues predominantly technical or factual, thereby promoting agreement on the remaining issues. Agencies using these alternatives could maintain or even enhance their authority if courts come to view negotiation and technical bodies as desirable approaches to decisionmaking and defer more readily to agencies who employ them. If so, greater use of negotiation and bodies of outside experts could well provide the elements of a new model of administrative law, in which the agencies would enjoy greater freedom from procedural formalities and judicial review, but under circumstances substantially different from those underlying the New Deal model of administration.

4. Decentralized Incentive Systems: Fees and Transferable Pollution and Nonperformance Rights

The greatest promise for promoting both market and social innovation lies in decentralized incentive systems, such as fees and transferable permits. Their adoption would present many problems of implementation and certainly would not eliminate uncertainties and other burdens on innovation. Moreover, the lack of useful common measures of social performance means that they cannot be applied to chemicals and automobile safety. Nonetheless, these alternatives have powerful virtues. They minimize constraints. They create effective and continuous demand for social innovation. They promise substantial reduction of compliance costs. They eliminate disproportionate burdens

331. Criteria for funding should be similar to those set forth by the Carter administration's regulatory reform proposals. *See* S. 755, 96th Cong., 1st Sess. § 302 (1979). Some pending regulatory reform proposals would require that an outside body, such as the Administrative Conference, make or supervise funding decisions in order to prevent "sweetheart" alliances between regulators and beneficiary or client groups. As previously explained, this danger would be greatly reduced if participants were funded in informal negotiations that would be followed by rulemaking proceedings, particularly if funding decisions were lodged in a branch of the agency, such as the general counsel's office, that had an interest in minimizing litigation delay and expense. The statute authorizing funding should so provide.

on new sources. They greatly reduce demands on the regulatory process to decide complex, detailed engineering and economic questions. They deserve widespread use.

Lack of experience with these alternatives counsels against simply scrapping the existing regulatory system and replacing it with fees or transferable permits. Champions of social regulation might well fear that such a step would drastically alter the terms of political debate and undermine social performance gains. Moreover, such a wholesale shift would create transitional uncertainties that might initially be more inimical to innovation than continuing the present system. Such drastic steps would in any event be politically infeasible.

Accordingly, decentralized incentive systems can better supplement the present command-and-control system in the case of conduct already subject to regulation and form the sole basis for government initiatives over certain forms of conduct not now subject to regulation. Emission fees may be most appropriate as an add-on to the existing regulatory base, in order to provide longrun incentives for social innovation in areas such as automobile emissions and stationary source discharges of conventional and toxic water pollutants. Transferable permits may be better adapted to deal with nonthreshold pollutants not now subject to regulation, such as sulfates and fine particulates. These generalizations must, however, be tested by examination of particular cases and by EPA efforts to promote banking and other extensions of the transferable permit system as a supplement to existing command-and-control systems.

The feasibility of decentralized incentive systems depends on advances being made in monitoring and enforcement technologies and capabilities, but these advances in any event are needed to make the existing regulatory system effective. Developing monitoring and enforcement capabilities will require regulatory attention to a fresh set of technical and engineering issues, but these are likely to be more generic than many of the industry-specific or firm-specific issues that regulatory agencies must now handle.

CONCLUSION

The four alternatives to command-and-control regulation described above are the most promising strategies with widespread applicability. They are by no means mutually exclusive. Requiring analysis of innovation impacts, modifying existing command-and-control regulatory tools, supplementing them with economic incentives, and encouraging alternatives to formal adversary decisionmaking could represent cumulative and complementary elements of a mixed strategy. However, extensive use of economic incentives would represent a sub-

stitute for the other three alternatives. By eliminating standard setting, it would also largely eliminate the need to modify or fundamentally change the existing process for deciding the detailed engineering and economic questions that standard setting entails. By relying on systematic positive incentives for innovation, it would eliminate the need to tinker with the existing command-and-control system in order to ameliorate its adverse effects on market innovation and improve its incentives for social innovation.

The first strategy is patchwork and incremental; the second represents a thoroughgoing departure from the status quo. There is no adequate empirical basis for comparing, in even the sketchiest way, their respective effects on innovation. But logic argues for the substantial longrun superiority of widespread use of economic-based incentives. No modification of the existing system of regulatory "sticks" can provide the same positive incentives for socially superior products and processes. No modification of the existing system can reduce regulatory constraints or so readily assure cost-effective allocation of abatement burdens as performance-based economic incentive systems. Transitional problems aside, such systems inherently involve far fewer case-by-case and industry-by-industry decisions, assuring lower decisional and delay costs. Patchwork, incremental modification of the existing system would mitigate some of the negative effects on innovation, but widespread use of economic-type incentives would eliminate many of them altogether.

These various approaches involve a basic choice between centralized and decentralized strategies of government intervention. Should we move in the direction of industry-by-industry "planning," or to decentralization strategies that incorporate market-based incentives, or to delegation of regulatory authority to state and local bodies? The present Administration is in some degree pursuing both alternatives. This Article argues that decentralized incentives are preferable but the alternative of "planning" for improved market and social performance has hardly been developed.

A related set of issues involves the continuation of legal controls over agency discretion. The alternatives of greater centralization or decentralization each necessarily involves a relaxation of existing restrictions on administrative discretion. A more centralized planning mechanism would be inconsistent with detailed statutory provisions and elaborate procedural requirements. Decentralization through market-based incentives delegates decisional discretion to private firms. Delegation to state and local authorities would carry with it an effective expansion of administrative discretion. Each would tend to reduce the degree of formal procedures required of agencies and the scope of judi-

cial review. Even patchwork modification of the existing system would, as developed above, involve more informal decisionmaking procedures and a likely increase in the scope of agency discretion. Accordingly, it appears that regardless of which strategy is chosen, the degree of legal formality and judicial control over regulatory activities is likely to decline.

While widespread use of economic incentives is the most promising generic solution to innovation problems, the potential of the case-by-case changes in strategy previously described as "redefining the problem" should not be overlooked. Regulation is characteristically targeted at the conduct of those industrial actors who appear most directly responsible for adverse effects, such as manufacturers of automobiles with low gasoline mileage. The typical response is to modify such conduct through a regulatory "technical fix." This response often overlooks the fact that targeted conduct is part of a larger system of incentives and activity and that a better way to achieve improved social performance may be to modify the larger system.

Examples of "redefining the problem" include, first, financial and regulatory incentives for utilities to invest in insulation and solar heating and cooling facilities in customers' homes as an alternative to expanding conventional generating capacity; second, providing information and other incentives to farmers to use integrated pest management procedures as an alternative to continued reliance on chemical pesticides; and third, increasing gasoline taxes as an alternative to regulation of new motor vehicle technologies. These approaches would open fresh possibilities for market as well as social innovation that are likely to be ignored under a technological fix approach.

Widespread adoption of decentralized economic incentives and case-by-case redefinition of the problem would each involve institutional changes. Much of the embedded political and social capital in existing institutions would have to be scrapped. Change involves costs, including transitional losses as well as uncertainty. These costs are likely to loom large, because the benefits of change are uncertain.

The premise of the market is that the dynamic gains from change will be large and will outweigh transitional losses. Market institutions impose these losses in an impersonal manner. When such losses are attributable to changes in government policy, they are no longer viewed as impersonal and beyond correction. Intervention to block change is relatively easy in a pluralistic, decentralized, fragmented polity such as ours. In the market context, those who benefit from change will reward firms who invest in those necessary changes. In the political arena, it is necessary to organize those who benefit from change to make a present impact on political decision—a far more difficult task.

For these and other reasons, government policy often follows the path of incremental "exfoliation."[332]

The current antiregulation mood sweeping the nation could provide the political power to make more ambitious institutional changes. Yet there are signs this energy simply will be directed at pruning the existing scheme of command-and-control regulation. This response would sacrifice social performance without achieving the market and social gains promised by basic institutional change.

The structure of government institutions rests ultimately on faith. Their performance under future circumstances can never be known with sufficient confidence to make institutional design a technological exercise. The uncertainties are most obvious when proposals for basic institutional change are presented. But the decision to maintain existing institutions in an era of rapid change must rest on faith as well. The integration of the United States in a world economy, the domestic difficulties it has experienced in providing adequate incentives for savings and investment, and the need to cope with environmental degradation for the indefinite future present such changes. While institutional choices rest on faith, that faith can to some degree be rationally examined. This Article argues that basic changes are necessary if we are to maintain the productive capability of the market economy while assuring our capacity to maintain a productive and healthy environment.

332. *See* J. KRIER & E. URSIN, *supra* note 209, at 287-95.