Loyola of Los Angeles Law Review

Volume 27
Number 3 *Symposium: Twenty-Five Years of Environmental Regulation*

Article 3

4-1-1994

Environmental Protection as a Learning Experience

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ENVIRONMENTAL PROTECTION AS A LEARNING EXPERIENCE

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In 1969 our environmental problems seemed clear, and the biggest question was whether we had the political will to adopt the obvious solutions. The first round of environmental statutes, which set ambitious goals and extremely short deadlines, reflected this assumpiton. Congress assumed that regulators had the information necessary to solve environmental problems, and needed only a stern mandate to spring into action.

As it has turned out, the political power of environmentalism has not been in question. In contrast, the information required for regulation has often proved unavailable, making references to scientific uncertainty commonplace in the environmental literature. The expansion of scientific knowledge has revealed new environmental problems, while sometimes raising questions about the seriousness of old ones. We have also learned a great deal about regulatory mechanisms, as we have seen some regulatory schemes work and other promising ideas fail.

Reviewing this history raises questions about the way we conceptualize environmental protection. For lawyers and policy analysts alike, the most natural approach is problem solving: identify an issue, assemble the available information, evaluate potential responses, and solve the problem. Courts also fall naturally into this mode, seeking to evaluate the cogency of agency decisions against a closed administrative record. In a relatively static world, policy makers do well to deliberate fully, so as to make each decision the best possible given current goals and available information.

In environmental law, however, every solution seems provisional and subject to reevaluation as new information appears and old solutions are tested against experience. Rather than viewing policy making as a one-shot exercise, in which the goal is to adopt the optimum solution based on current information, we might do better to think of a continuous process of learning and experimentation. "What is the optimum decision today?" may be less important than "What is the best strategy for developing and responding to new information about the problem?" In

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other words, the key question may be how to engage in effective learning in this regulatory setting.

I. WHERE ARE WE?

Because environmental law is so complex and technical, any effort at overall assessment necessarily comes at the price of ruthless oversimplification. Nevertheless, such an assessment is necessary if we are even going to begin to think about future directions for environmental law. What follows is an abbreviated—and undoubtedly subjective—appraisal of the lessons we have learned since 1969.

A. Environmental Protection as a Goal

It would have been quite reasonable in 1969 to wonder whether environmentalism was a passing fad. As events unfolded, however, environmentalist attitudes quickly solidified. In 1972 an estimated twenty million Americans participated in Earth Day. More than 2000 colleges, 10,000 high schools and elementary schools, and 2000 communities took part. Some twenty years later, the reverberations were still being felt as millions of people celebrated the anniversary of Earth Day.[1]

Environmentalism has been remarkably durable. In 1989 eighty percent of the population agreed that "[p]rotecting the environment is so important that requirements and standards cannot be too high, and continuing environmental improvements must be made regardless of cost."[2] Other studies of public opinion characterize environmentalism as a "consensual" value in American society.[3]

Indeed, environmentalist attitudes are now nearly omnipresent in American society.[4] With what must have been a certain sense of irony,

1. Robert Cahn & Patricia Cahn, *Did Earth Day Change the World?*, ENV'T, Sept. 1990, at 16, 18-19, 37; *see* COUNCIL ON ENVTL. QUALITY, ENVIRONMENTAL QUALITY: TWENTIETH ANNUAL REPORT 4-5 (1990).

2. Roberto Suro, *Grass-Roots Groups Show Power Battling Pollution Close to Home*, N.Y. TIMES, July 2, 1989, at A18. It is doubtful that voters would really support environmental regulation "regardless of cost," but their willingness to endorse this statement does show that they place a high value on the environment. *Cf.* Richard L. Berke, *Oratory of Environmentalism Becomes the Sound of Politics*, N.Y. TIMES, Apr. 17, 1990, at A1 ("The environment . . . has reached the forefront of American politics, with candidates for one public office after another proclaiming themselves environmentalists.").

3. *See generally* Riley E. Dunlap, *Public Opinion and Environmental Policy*, *in* ENVIRONMENTAL POLITICS AND POLICY: THEORIES AND EVIDENCE 4 (James Lester ed., 1989) (describing evolution of public opinion over past three decades and impact on politics and society).

4. *See* Mark Sagoff, Three Essays on Ethics and the Environment 1 (Dec. 10, 1990) (unpublished manuscript, on file with author).

George Bush's head of the Office of Management and Budget (OMB) once offered a particularly vivid description of this situation:

> "Increasingly, we are all environmentalists. . . . The President is an environmentalist. Republicans and Democrats are environmentalists. Jane Fonda and the National Association of Manufacturers, Magic Johnson and Danny Devito, Candace Bergen and The Golden Girls, Bugs Bunny and the cast of Cheers are all environmentalists."[5]

Today, environmentalist attitudes are found in publications that cater to a broad range of groups, from farm journals to car and truck magazines.[6] Furthermore, environmentalism is surprisingly strong even in underdeveloped countries. For example, 29% of those surveyed in Mexico volunteered that environmental problems were among the most serious facing that country, while 45% of Nigerians rated their country's environmental problems as "very serious."[7]

At least for now, the goals of environmental law seem more deeply entrenched than might have been expected in 1969. The more pressing question today is the choice of means. One of the more obvious lessons we have learned since 1969 is that aspirations do not automatically translate into environmental improvements. How well have we succeeded in achieving our environmental goals?

B. Evaluating the Current Regulatory System

Post-1969 environmental law has had some important successes. Despite some disappointments, current regulatory schemes have produced genuine improvements in environmental quality. For instance, between 1970 and 1987, lead emissions declined 96% and sulfur dioxide emissions dropped 28%.[8] Emissions of other air pollutants declined or remained relatively constant despite substantial economic and population growth. This record is especially impressive because the gross national product increased by 72% and automobile use increased by about 50%—in the same period.[9] Although these improvements might have been ob-

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5. *Id.* (quoting Richard Darman, Keeping America First: American Romanticism and the Global Economy, Address at the Second Annual Albert H. Gorden Lecture, Harvard University (May 1, 1990)).

6. *See* Mark Sagoff, *Settling America or the Concept of Place in Environmental Ethics*, 12 J. ENERGY NAT. RESOURCES & ENVTL. L. 349, 414-16 (1992).

7. Riley E. Dunlap et al., *Of Global Concern: Results of the Health of the Planet Survey*, ENV'T, Nov. 1993, at 7, 9-10.

8. COUNCIL ON ENVTL. QUALITY, *supra* note 1, at 8.

9. *Id.* at 8-9.

tained at lower cost, environmental statutes clearly have created important public benefits.[10]

Despite these accomplishments, the current regulatory system is far from perfect. Critics convincingly point out two flaws in the Environmental Protection Agency's (EPA) efforts to mandate higher levels of pollution control.[11] First, imposing high levels of pollution control is sometimes quite wasteful in terms of any corresponding environmental benefit. For instance, the Federal Water Pollution Control Act Amendments of 1972[12] required two west coast paper mills to install expensive pollution control equipment, the Pacific Ocean harmlessly diluted the pollution.[13] It took a special act of Congress to rectify the situation.[14]

Second, this method of pollution control is inherently cumbersome. The EPA must learn the pollution control technologies and economic conditions in each industry to determine the best available technology. A major EPA rule may require tens of thousands of pages of documentation, including careful responses to dozens of arguments raised by the industry.[15] Even with all this effort, the EPA cannot fully master the economics and technologies of dozens of industries, from petrochemicals to steel to electric utilities. It is bound to make mistakes in both directions: asking more than some industries can reasonably achieve and letting others off too lightly.[16] Because the regulatory process is so

10. *See, e.g.*, CASS R. SUNSTEIN, AFTER THE RIGHTS REVOLUTION: RECONCEIVING THE REGULATORY STATE (1990). Even in Los Angeles air quality has substantially improved. *See* James M. Lents & William J. Kelly, *Clearing the Air in Los Angeles*, SCI. AM., Oct. 1993, at 32.

11. Unfortunately, the current regulatory system is not easy to explain because the federal pollution statutes have grown to be almost as complicated as the Internal Revenue Code. Basically, the Clean Water Act requires polluters to use the highest feasible degree of pollution control. *See* 33 U.S.C.A. §§ 1251-1387 (West 1986 & Supp. 1993). The Clean Air Act has similarly explicit requirements for new pollution sources, but a different set of legal rules aimed primarily at existing polluters. *See* Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2399 (codified in scattered sections of 42 U.S.C.); Clean Air Act Amendments of 1977, Pub. L. No. 95-95, 91 Stat. 685 (codified as amended in scattered sections of 42 U.S.C.). In practice, however, existing polluters are often also held to a feasibility standard.

12. Pub. L. No. 92-500, 86 Stat. 816 (codified as amended in scattered sections of 33 U.S.C.A.).

13. *See* Crown Simpson Pulp Co. v. Costle, 642 F.2d 323 (9th Cir.), *cert. denied*, 454 U.S. 1053 (1981). The lack of harmful effects of these discharges does not seem to have been in serious dispute.

14. *See* Clean Water Act of 1977, Pub. L. No. 95-217, 91 Stat. 1566 (codified as amended at 33 U.S.C.A. §§ 1251-1387 (West 1986 & Supp. 1993)).

15. The courts have done a great deal to make this process even more cumbersome than necessary. *See infra* part II.B.

16. The crux of these criticisms is that the EPA has the desire to regulate but not enough information, while industry has all the information but little incentive to use it. If regulations were tailored to each individual plant, society could receive equally clean air and water but

cumbersome, these mistakes are difficult to correct when they are later discovered.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)[17] is the most notable deviation from this regulatory model. Rather than relying upon extensive EPA regulations to clean up existing hazardous waste sites, CERCLA attempts to use civil liability as its main instrument for environmental protection. Unfortunately, the nearly universal consensus is that this experiment has been unsuccessful. As Peter Menell reports,

> The extraordinary social cost of this litigation can be pieced together from a variety of sources. EPA spends approximately 12 percent of Superfund monies on enforcement, which includes litigation costs, data collection and review, and report preparation. [One study] estimates the total (private and governmental) transaction costs of CERCLA liability to be between 24 and 44 percent of the direct costs of clean-up. The Office of Technology Assessment (1985) estimates that the National Priority List could reach 10,000 sites, costing in excess of $100 billion to remedy. With rapidly escalating remediation costs, in part attributable to stricter clean-up standards enacted in 1986, the *transaction costs* of CERCLA's clean-up effort could exceed $44 billion.[18]

Despite these large transaction costs, relatively little actual "cleaning up" seems to have taken place.[19]

As disappointing as CERCLA has been in achieving its goals, it has an even more fundamental flaw. The scientific premise of the statute was that hazardous waste, and toxic chemicals more generally, present an urgent public health risk. As we will see in the next section, however, scientific evidence has rapidly evolved, leaving environmental policy struggling to keep up.

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perhaps at a much lower price. Society could then spend some of the savings on an even higher level of pollution control, benefitting industry while upgrading the environment.

17. 42 U.S.C. §§ 9601-9675 (1988 & Supp. III 1991).

18. Peter S. Menell, *The Limitations of Legal Institutions for Addressing Environmental Risks*, 5 J. ECON. PERSP. 93, 108 (1991) (citation omitted).

19. According to recent reports, fewer than 70 of the 1275 sites on the National Priorities List have been cleaned up. Rudy Abramson, *The Superfund Cleanup: Mired in Its Own Mess*, L.A. TIMES, May 10, 1993, at A1.

C. Scientific Uncertainty

In the early 1970s toxic chemicals were thought to be a major cancer threat. Consequently, leaking hazardous waste sites were considered a clear and present danger to the public health. Rigorous regulation followed in the form of the Resource Conservation and Recovery Act of 1976 (RCRA),[20] which was primarily aimed at future waste disposal, with CERCLA providing stringent clean-up requirements for existing waste sites. By the time these statutes were in place, however, their scientific basis was already eroding.[21]

Dioxin exemplifies the changing scientific view of carcinogens. At one point dioxin was considered the most deadly carcinogen in existence, even in microscopic doses. It still retains that reputation with the public, but scientific opinion has moved in the opposite direction. By 1991, based on evidence that dioxin can only cause harm after binding to certain cellular receptors, scientists argued that it might well be noncarcinogenic below certain exposures.[22] Recent empirical data also raise questions about the dangers of dioxin. A factory explosion in 1976 exposed 37,000 people to high levels of dioxin. A recent epidemiological study revealed worrisome increases in some cancers, but the overall cancer rate was actually lower than the rate among the general population.[23]

Although dioxin and other toxic chemicals seem to be less dangerous than once believed, scientific knowledge is equally capable of confirming rather than undermining the argument for preventive measures. When international negotiations began in 1986, it was quite unclear whether the ozone layer was actually in any danger. Although more convincing evidence relating to the Antarctic ozone "hole" began to appear during the negotiations, it was only later that a scientific consensus

20. Pub. L. No. 94-580, 90 Stat. 2795 (codified as amended at 42 U.S.C.A. §§ 6901-6992k (West 1983 & Supp. 1993)).

21. *See* Brian E. Henderson et al., *Toward the Primary Prevention of Cancer*, 254 SCI. 1131, 1137 (1991).

22. Leslie Roberts, *Dioxin Risks Revisited*, 251 SCI. 624 (1991).

23. Keith Schneider, *2 Decades After Toxic Blast in Italy, Several Cancers Show Rise*, N.Y. TIMES, Oct. 26, 1993, at B6. The EPA now seems to be planning to reaffirm the dangers of dioxin. Interestingly, the primary danger seems to be from airborne dioxin (which contaminates food supplies), not from hazardous waste sites. *EPA Dioxin Draft to Affirm Cancer Risks, Highlight Non-Cancer Effects*, INSIDE EPA WKLY. REP., Jan. 14, 1994, at 1-2. There is some reason to believe that dioxin actually inhibits the development of certain cancers, rendering the situation all the more confusing.

emerged.[24] Even today, however, there are major uncertainties about the causal mechanisms and effects of ozone depletion.[25]

Similar uncertainties exist regarding other major environmental issues. For example, after a careful review of the evidence regarding the greenhouse effect, Christopher Stone found the data much less clear than he expected:

> [H]aving recited in a draft the popular menace that the polar ice caps were ready to melt on us and so on, I waited for the authoritative backing to materialize in memos [from Stone's research assistant]. I waited in vain. The deeper into the better authorities we fished, the vaguer and more qualified the projections we landed. . . . Over the space of the few years that I have been following the research developments, all of the original, highly publicized projections of climate change variables have without exception crept back to much more modest levels than in the original scare stories.[26]

Similarly, despite well-founded concerns about the danger to biodiversity, we are just beginning to obtain basic data such as how much of the Amazon forest we are losing.[27]

It is tempting to think that we understand environmental risks and need only to find appropriate solutions. The reality is that we are faced with a high degree of uncertainty. But that uncertainty is not static—scientists are constantly improving our information base. These realities must help shape any intelligent strategy of environmental protection.

D. What Have We Learned?

Looking back over the last twenty-five years of environmental law, one cannot help but be struck by how much we have learned. We have discovered that regulatory efforts that seemed plausible when enacted can often prove disappointing in practice. We have found that the scien-

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24. *See* RICHARD E. BENEDICK, OZONE DIPLOMACY: NEW DIRECTIONS IN SAFEGUARDING THE PLANET 17-18 (1991).

25. Gary Taubes, *The Ozone Backlash*, 260 SCI. 1580, 1583 (1993). For a report on the current status of ozone research, see Jose M. Rodriguez, *Probing Stratospheric Ozone*, 261 SCI. 1128 (1993).

26. CHRISTOPHER D. STONE, THE GNAT IS OLDER THAN MAN: GLOBAL ENVIRONMENT AND HUMAN AGENDA at xvi-xvii (1993). For Stone's review of the evidence, see *id.* at 13-16, 20-25. Stone goes on to conclude, correctly in my view, that despite substantial uncertainties the possibility of global climate change should be taken very seriously. *See id.* at 26-32. It should be noted that long-term predictions (over a 200-500 year period) remain quite gloomy. *See* Richard A. Kerr, *No Way to Cool the Ultimate Greenhouse*, 262 SCI. 648 (1993).

27. *See* David Skole & Compton Tucker, *Tropical Deforestation and Habitat Fragmentation in the Amazon: Satellite Data from 1978 to 1988*, 260 SCI. 1905 (1993).

tific basis for environmental protection can shift quickly. Indeed, we have learned that our environmental agenda itself is subject to constant revision; we learn that some problems are under control or are less serious than we thought, while at the same time we discover previously unforseen environmental problems.

Strangely enough, however, we do not seem to have adapted to the reality of this constant change. Subconsciously, we seem to assume that, whereas much of what we believed five or ten years ago is outmoded, we are now finally in a good position to make permanent decisions about the environment. Thus, we still seem to conceptualize environmental protection in static terms: Given the information now available, what is the best solution to a given environmental problem?

When information changes slowly, this may be the best way to think about public policy. But when the information base is itself subject to rapid change, a more dynamic approach is needed. It makes little sense to agonize over today's decision when it is likely to require revision tomorrow anyway. Moreover, given the inadequacy of our current information, developing new information is a critical need. Finally, because of inadequate information, predictions about a decision's effects have only limited value. Instead, we need to focus on experimentation, trying many different things and attempting to learn from the results.

In a nutshell, one of the main lessons we should learn from the last twenty-five years is the centrality of learning to the enterprise of environmental protection. The remainder of this Essay attempts to work out some of the implications of that lesson.

II. TOWARD EFFICIENT METHODS OF ENVIRONMENTAL LEARNING

There are two different strategies for improving environmental learning. One is decentralization—moving decision making from large federal bureaucracies to the private sector or to smaller units of government. The other is to streamline the federal regulatory process—trying to perform the proverbial organizational task of "teaching the elephant to dance." I will consider these strategies in turn.

A. Decentralizing Decision Making

Large hierarchies are not famous for their ability to respond quickly and effectively to change.[28] In order to sensibly allocate pollution restrictions, it is necessary to learn a great deal about the technological and

28. In the private sector one need only consider the difficulties encountered by even a "model" corporation such as IBM in a period of extremely rapid change.

economic circumstances of polluters. Because these conditions are subject to rapid change, and because of the inherent delays of centralized decision making, the EPA may be unable to keep up with these changes. By decentralizing environmental decision making, subject to appropriate controls, we may be able to improve the responsiveness of environmental protection to changing circumstances and new information.

Markets are one form of decentralization. In theory, markets can be extraordinarily swift and efficient ways of integrating the information available to individual firms. Can these strengths of market institutions serve the environment?

The standard arguments for incentive schemes focus on their static efficiency. If economists are right, these schemes should do a good job of allocating responsibility for pollution control among various polluters at any given time. For present purposes, however, dynamic efficiency may be even more important. Markets can be remarkably adept at responding quickly to new information. Consider, for example, the recent decision by a brokerage firm to purchase a supercomputer in order to shave two seconds off the firm's response time for shifts in the Tokyo stock market.[29] Although this example certainly cannot be considered typical, it does highlight how markets can force firms to learn quickly from new information. Thus, one method to expedite learning is to organize a market.

Economists have designed ingenious incentive systems to create markets for environmental protection. Some promising efforts have been made at implementation, the most ambitious being the new system of marketable sulfur dioxide allowances under the Clean Air Act Amendments of 1990.[30] We cannot be sure that the theoretical arguments for incentive schemes will apply equally to their actual implementation. Nevertheless, they are certainly worth a serious try.[31]

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29. *Survey: Frontiers of Finance*, THE ECONOMIST, Oct. 9, 1993, at 60, survey at 4.

30. Pub. L. No. 101-549, 104 Stat. 2399 (codified as amended in scattered sections of 42 U.S.C.).

31. Although these incentive systems are promising, we should not be overly confident about translating that theory into practice. Real-world implementation of regulatory reform may raise significant practical problems and conflict with other goals like equity. For arguments in favor of technology-based standards on these grounds, see Jerry L. Mashaw, *Imagining the Future; Remembering the Past*, 1991 DUKE L.J. 711, 721-23; Joel A. Mintz, *Economic Reform of Environmental Protection: A Brief Comment on a Recent Debate*, 15 HARV. ENVTL. L. REV. 149 (1991); and Sidney A. Shapiro & Thomas O. McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729. Moreover, the actual legal enactments are likely to differ considerably from the elegant theoretical models, if only for political reasons. Compare the intellectual elegance of the concept of an income tax with the notorious complexity of the Internal Revenue Code!

Federalism provides another possible form of decentralization. Under our current approach to regulation, most important standards are set in Washington. One result is that regulations tend to be insensitive to differences in technological and economic constraints and to variations in environmental problems. It is difficult for the EPA to learn enough about these differences. The problem might be reduced by shifting more front-line regulatory authority to the states, subject to streamlined federal supervision.

The Clean Water Act is a good illustration. The current regulatory scheme gives the EPA control over pollution standards, with limited discretion for state regulators. Under an alternate approach once favored by industry, the EPA would have established ranges of effluent limits for various industrial categories, as well as a list of factors to be used in making choices within that range. The states would then have chosen limits for individual plants within that range, subject to the EPA's veto. The Supreme Court rejected this approach largely for statutory reasons, but was also concerned about the impracticality of requiring the EPA to review thousands of state-issued permits.[32] Today, however, "[w]e can generate, analyze, and communicate a thousand times more information than we could just a generation ago, for a fraction of the cost."[33] Given modern methods of statistical quality control, the EPA *could* provide effective oversight for an individualized permit issuance system.[34]

This approach would have several advantages over the current regulatory scheme. It would reduce the costs of "one size fits all" regulation by allowing closer tailoring of effluent limits to the needs of individual

32. *See* E.I. du Pont de Nemours & Co. v. Train, 430 U.S. 112, 132-33 (1977). Despite the limits of the state role under the current regulatory scheme, some successful state innovation in water pollution control has taken place. *See* WILLIAM R. LOWRY, THE DIMENSIONS OF FEDERALISM: STATE GOVERNMENTS AND POLLUTION CONTROL POLICIES 73-78 (1992).

33. DAVID OSBORNE & TED GAEBLER, REINVENTING GOVERNMENT: HOW THE ENTREPRENEURIAL SPIRIT IS TRANSFORMING THE PUBLIC SECTOR 141 (1992).

34. Efficient systems to oversee even 42,000 permits (the number given by the *du Pont* Court, *see* 430 U.S. at 132-33) do not seem out of the question. Consider, for example, the vastly greater number of Medicare claims or income tax returns that must be screened annually. For example, the EPA might create a model to predict effluent limitations for plants having particular characteristics; the model could be based on economic or engineering theory, or it could incorporate statistical studies of actual permits from other states. Permits straying too far from the prediction would be automatically audited, as would a random sample of other permits. For an insightful analysis of a similar proposal for the use of statistical claim profiles in tort cases, see Glen O. Robinson & Kenneth S. Abraham, *Collective Justice in Tort Law*, 78 VA. L. REV. 1481 (1992). As an incentive, there could be a monetary penalty for rejected permits (with arbitration of any disputed claims). No doubt, an expert on quality control could devise a much better system, but even this rough sketch suggests that a solution is feasible.

plants. Also, because the EPA guidelines would be more flexible than the current regulations, they could justifiably be less precise and less heavily documented. This could help streamline the rule-making process and might encourage judges to ease the intrusiveness of judicial review. Finally, the permit limitations established by different states could provide valuable new information, so that the EPA could adjust the guidelines based on experience.[35]

Under this approach delegation to the states would be used to increase the responsiveness of regulation to local conditions. Increased delegation could also be used to help learn about possible new regulatory methods. The Brandeisian ideal of states as laboratories takes on a new relevance today. One of the things we have learned about environmental regulation is that good ideas do not always work out in practice. No matter how much we try to improve the regulatory process, many of our best ideas will fail while less promising ideas sometimes will be unexpectedly successful. Or, more bluntly, we are always going to make a lot of mistakes. Given this reality, we ought to run a lot of experiments to test regulatory proposals.

There are obvious risks in delegating too much authority to states that may lack the resources, expertise, or political will to implement innovative environmental programs. But these risks are not insurmountable. Subject to some safeguards, we could give the EPA broad authority to contract with selected states to create innovative programs.[36] The result would be to encourage the states to innovate to find better ways of meeting environmental goals. Successful state programs could then operate as models for other states or be incorporated into federal law. Unsuccessful state programs are nearly as important, since observing them may save us from making costly errors on a national scale.

B. Making Regulatory Agencies More Dynamic

No matter how much we try to decentralize, federal agencies like the EPA are still going to be making important regulatory decisions.

35. For example, if a state with generally stringent standards is found to be issuing permits with low requirements for a category of sources, the EPA might want to consider whether its initial technological expectations were too high. On the other hand, the issuance of unexpectedly strict permits by some states might trigger a reappraisal in the opposite direction.

36. These contracts would only be available to states that had demonstrated the capacity to run an effective regulatory program. The contract would contain quantitative performance measures: specific levels of air or water quality to be met by particular dates. Failure to achieve these standards would result in financial penalties against the state or in cancellation of the contract. Finally, minimum federal standards would remain in place as a safeguard against risks to public health or irreparable environmental damage.

Our current regulatory paradigm focuses on maximizing the quality of each individual agency decision. Except in a static situation, however, this may not optimize regulatory outcomes over time. We need to move agencies toward a more dynamic mode, in which regulation is viewed as an ongoing cycle of experimentation and evaluation.

It seems rather painfully obvious that we cannot expect to improve environmental quality if we do not even know the current state of the environment. Unfortunately, our pollution monitoring is strikingly inadequate.[37] With regard to toxics, the EPA's information base was so weak that it was shocked by the huge discharges revealed when companies made the disclosures mandated by the Emergency Planning and Community Right-to-Know Act of 1986.[38] We urgently need better information about the present condition of the environment. Otherwise, we will never be capable of monitoring the effectiveness of our current efforts, which is a necessary prerequisite of learning to do better.

We also need much better follow up on specific regulatory mechanisms. For example, as we have seen, incentive schemes present exciting possibilities for making environmental protection more cost effective. But we badly need to know how well the schemes work in practice. Unfortunately, as two leading environmental economists observe, "In spite of the potential importance of emissions trading as an alternative to conventional regulatory approaches, surprisingly little effort has been spent evaluating the impact of this program."[39] Extensive follow-up studies on existing programs should be a high priority. It makes little sense to continue pouring resources into programs with so little effort to evaluate their effectiveness.

In an ideal world the desirability of improved information would immediately translate into a higher EPA budget for research and data collection. Given the federal deficit, this is an unlikely prospect; indeed, the EPA has been struggling to return its research budget to pre-Reagan levels.[40] Some funds can be reallocated from other EPA activities, but this too has its limits. Consequently, we need to find ways to enlist in-

37. *See* ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 793, 866 (1992). For a survey of environmental monitoring and calls for improvement, see COUNCIL ON ENVTL. QUALITY, ENVIRONMENTAL QUALITY: TWENTY-SECOND ANNUAL REPORT 43-56 (1992).

38. Pub. L. No. 99-499, 100 Stat. 1728 (codified at 42 U.S.C. §§ 11001-11050 (1988 & Supp. III 1991)); *see* PERCIVAL ET AL., *supra* note 37, at 624.

39. Robert W. Hahn & Gordon L. Hester, *Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program*, 6 YALE J. ON REG. 109, 109 (1989).

40. *See* Robin Shifrin, *Not by Risk Alone: Reforming EPA Research Priorities*, 102 YALE L.J. 547, 563 n.72 (1992).

dustry in this process. Existing law contains several mechanisms relating to information generation. Pollution permits often require monitoring and reporting of data, and these requirements can be expanded. Indeed, there is precedent for requiring regulated parties to finance research.[41] Despite some implementation problems, statutes such as the Toxic Substances Control Act (TSCA)[42] and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)[43] also provide a basis for more creative data generation requirements in the private sector.[44] Once information is obtained, we also need better systems for accessing the data bases.[45]

The possibility of acquiring relevant new information can also significantly change standards for decision making. What economists call "hysteresis effects" can dramatically modify the results of a conventional cost-benefit analysis.[46] Although the mathematical analysis is complex, the basic idea is not difficult to understand. If a decision has irreparable consequences, then it may be worth delaying the decision in order to obtain new information. Taking an irreversible step forecloses the possibility of future learning, and therefore incurs an extra cost that does not show up in the usual cost-benefit analysis.[47] In a formal sense waiting is equivalent to purchasing an option contract, and under many circumstances that option has positive value. Under some circumstances taking this option value into account can change the standards for decision making. It is not unusual to find that an irreversible project should not

41. *See* Kennecott Copper Corp. v. Train, 526 F.2d 1149 (9th Cir. 1975), *cert. denied*, 425 U.S. 935 (1976) (upholding EPA requirement that firm undertake research program to improve pollution control technology).

42. 15 U.S.C. §§ 2601-2671 (1988 & Supp. IV 1992).

43. 7 U.S.C. §§ 136-136y (1988 & Supp. IV 1992).

44. *See* John S. Applegate, *The Perils of Unreasonable Risk: Information, Regulatory Policy, and Toxic Substances Control*, 91 COLUM. L. REV. 261, 318-32 (1991).

45. *See* Mary L. Lyndon, *Information Economics and Chemical Toxicity: Designing Laws to Produce and Use Data*, 87 MICH. L. REV. 1795, 1840-55 (1989). Environmental impact statements could also provide another major source of environmental data, if they were properly integrated into a database.

46. *See* Avinash Dixit, *Investment and Hysteresis*, 6 J. ECON. PERSP. 107 (1992). The basic point is that "[w]here there is uncertainty, there may be learning." W. Kip Viscusi & Richard Zeckhauser, *Environmental Policy Choice Under Uncertainty*, 3 J. ENVTL. ECON. & MGMT. 97, 108 (1976).

47. For example, suppose that a project now has a 40% chance of producing a $1 million loss, and a 60% chance of netting a $1 million gain. This looks like a good investment, since the expected profit is $200,000. On the other hand, suppose that by waiting six weeks, we can know the outcome of the investment with certainty. We will then invest in the project 60% of the time, for an expected gain of $600,000, with no losses (since we will know not to invest in the loss situation). Hence, the value of waiting is $600,000 minus $200,000, or $400,000. Even if we factor in the time value of money, waiting looks like the wise decision, because making an immediate decision deprives us of the opportunity to obtain further information at a time when it can still do us some good.

be undertaken unless its expected benefits are twice as much as its cost.[48] Otherwise, it is often better to wait for more information.

Given the magnitude of uncertainty and the likelihood of obtaining more information, hysteresis effects may be quite important in environmental law. Often, these effects push the balance toward environmental regulation. Destroying a rain forest or an endangered species is irreversible. Usually, whatever benefits can be obtained from the action will be available if we wait, while the uncertainty about costs will be reduced. Hence, there is a good argument for waiting while attempting to learn more.

On the other hand, hysteresis effects may disfavor certain forms of pollution control. Large capital expenditures for pollution control are likely to be unrecoverable if it turns out that better technologies become available, or that the harm caused by the pollution has been overestimated. Simply waiting for more information may be unacceptable, but it may be worth considering less capital-intensive methods of control. Examples that come to mind include the use of respirators by workers to deal with airborne occupational hazards, or the use of low-sulfur coal rather than scrubbers to deal with acid rain. These alternatives may not be the best solutions, but they can buy time while we seek more information.

Rather than taking advantage of the possibility of dynamic learning, an agency may invest its resources in making each individual regulatory decision as nearly perfect as possible. It may seem obvious that an improved decision is always worthwhile. In a world of limited staff and budget, however, improvements in quality come at the expense of delay and reduced output. Moreover, by the time all the data has been sifted through and all the analytical bases have been covered, the world may have changed.[49] The agency may find that the scientific data or technological and economic constraints have shifted, leaving it with the choice

48. *See* Dixit, *supra* note 46, at 116. See *id.* at 117, 120 for other examples of the magnitude of hysteresis effects. Sometimes, we may be uncertain about the degree of irreversibility itself, and here too the possibility of learning must be taken into account. *See* Viscusi & Zeckhauser, *supra* note 46, at 107-08.

49. Consider Lee Iacocca's remarks to an executive who helped delay the adoption of front-wheel drive vehicles by Ford:

> "The trouble with you, Phil, [he said], is that you went to Harvard, where they told you not to take any action until you've got all of the facts. You've got ninety-five percent of them, but it's going to take you another six months to get that last five percent. And by the time you do, your facts will be out of date because the market has moved on you."

DAVID HALBERSTAM, THE RECKONING 516 (1986) (quoting Lee Iacocca).

of either starting over or closing the record and adopting a potentially obsolete regulation.[50]

Agencies have been pushed toward static decision making by "hard look" judicial review, under which courts closely scrutinize the administrative record to ensure agency rationality. Jerry Mashaw and David Harfst have detailed how the federal automobile safety program was brought to a standstill by judicial obsession with obtaining a full record.[51] It is not difficult to find cases in which the EPA's technical decisions have been overturned by courts demanding further documentation and more careful analysis.[52] Despite the initial appeal of hard look review, there is substantial support for Thomas McGarity's recent appraisal:

> The predictable result of stringent "hard look" judicial review of complex rulemaking is ossification. Because the agencies perceive that the reviewing courts are inconsistent in the degree to which they are deferential, they are constrained to prepare for the worst-case scenario on judicial review. This can be extremely resource-intensive and time-consuming. Moreover, since the criteria for substantive judicial review are the same for repealing old rules as for promulgating new rules, the

50. Agencies may be trapped in a vicious circle. Because decision making is so cumbersome, it is costly to reconsider existing regulations. Knowing that revisions will be difficult, the agency puts even more stress on perfecting each regulatory decision. This in turn raises the cost of issuing regulations, and the cycle continues. One way of escaping the cycle might be to adopt formulas or regulatory methodologies rather than specific numerical standards, so that some adjustments could be made automatically. The analogy is to the use of cost-of-living adjustment standards to adjust for inflation.

51. *See generally* JERRY L. MASHAW & DAVID L. HARFST, THE STRUGGLE FOR AUTO SAFETY (1990).

52. *See, e.g.*, Corrosion Proof Fittings v. EPA, 947 F.2d 1201 (5th Cir. 1991) (overturning EPA's carefully considered asbestos regulations, effectively wrecking its most serious effort to implement Toxic Substances Control Act). It is not unfair to say that the Fifth Circuit's opinion

> is so lacking in deference to the agency's exercise of expertise and policy judgment, and so full of attempts to impose on the agency the judges' own views of the proper role of regulation in society, that it is virtually indistinguishable from the documents that OMB prepares in connection with its oversight of EPA rulemaking.

Thomas O. McGarity, *Some Thoughts on "Deossifying" the Rulemaking Process*, 41 DUKE L.J. 1385, 1423 (1992).

Other judges have not hesitated to correct agencies on technical issues such as choice of the proper computer model. *See, e.g.*, AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir. 1992) (demanding that agency separately document health effects for each of 428 toxic substances, although OSHA argued this was scientifically infeasible); Ohio v. EPA, 784 F.2d 224 (6th Cir.), *aff'd*, 798 F.2d 880 (6th Cir. 1986) (rejecting EPA computer model); Gulf S. Insulation v. Consumer Prods. Safety Comm'n, 701 F.2d 1137 (5th Cir. 1983) (second guessing agency's decision on technical issues).

> agencies are equally chary of revisiting old rules, even in the name of flexibility.[53]

It is tempting to suggest abandoning the hard look doctrine. The proper level of judicial review is, however, a complex question. Hard look review has been used for various purposes, ranging from the effort to keep the agency from ignoring its statutory mandate, to efforts to improve the technical quality of agency decisions. Moreover, the proper scope of review is an issue that may arise in different settings, involving different agencies, statutes, and policy concerns. Despite its drawbacks, hard look review may sometimes be justified in at least some of these settings.

Rather than seeking a global change in the level of judicial scrutiny, we might do better to vary the level of review depending on whether the agency is taking a dynamic or static approach to regulation. A sensible approach would be to lower the scope of review when an agency plans to monitor a rule's implementation and make appropriate modifications. In light of the previous discussion, we might lower the level of review when the agency can demonstrate that (1) its action will not cause irreparable injury; (2) it has taken steps to generate additional relevant information; and (3) it has a process in place that will in fact result in a reappraisal of current policy as the new information is developed. When these factors are present, a more deferential form of judicial scrutiny is wise, and indeed, provides an incentive for agencies to shift toward dynamic regulation.

III. CONCLUSION

This Essay considers how environmental protection can function more effectively, given the high degree of uncertainty and our rapidly evolving understanding of environmental problems. The solutions include decentralization—more use of markets and federalism—as well as making learning strategies more central to environmental regulation. Such improvements are only worth considering, however, if there is some prospect of regulatory reform—a possibility that some might consider remote. Nevertheless, there are grounds for hope that improvements can actually be implemented.

It would be naive to assume that once they are identified, better methods of environmental protection will automatically be adopted. Politicians and bureaucrats have incentives that do not always correspond to the public interest. We cannot simply ignore the problem of incentive

53. McGarity, *supra* note 52, at 1419-20 (citations omitted).

design; indeed, as lawyers, it should be one of our continuing focuses. Nevertheless, at least in the environmental area, mechanisms seem to have evolved for at least roughly translating the public's values into operational form.[54] It seems reasonably likely that if improved methods of environmental protection can be identified, political strategies can be found for implementing them.

54. *See* Daniel A. Farber, *Politics and Procedure in Environmental Law*, 8 J.L. ECON. & ORGANIZATION 59 (1992).