A Beginning and Not an End in Itself: The Role of Risk Assessment in Environmental Decision-Making

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A BEGINNING AND NOT AN END IN ITSELF:
THE ROLE OF RISK ASSESSMENT IN
ENVIRONMENTAL DECISION-MAKING

John S. Applegate*

INTRODUCTION

Congress has discovered risk assessment, and the new congressional majority seems determined to make risk the centerpiece of its efforts to rein in federal environmental regulation. The Republican majority is responding to a barrage of criticism from industry that environmental regulation is Draconian in its stringency and that its costs are out of all proportion to its benefits. Unduly pessimistic risk assessments—bizarre exposure scenarios, consistently conservative assumptions, and cumulative conservatism—have been identified as aiding and abetting highly protective regulation. As a result, several bills have been introduced in the 104th Congress to reform risk assessment as a means of moderating the impact of the underlying environmental legislation.

The Democratically controlled 103d Congress considered several bills to require additional use of risk assessment methodologies, but except for a modest requirement in the Department of Agriculture Reorganization Act, none was enacted. The Clinton administration also developed a comprehensive set of principles for regulatory reform in Executive Order No. 12,866, which requires a thorough analysis of

* James B. Helmer, Jr., Professor of Law, University of Cincinnati. This Article is an expanded version of testimony before the United States Senate Committee on Energy and Natural Resources on March 6, 1995. I have been aided immensely in my thinking about these issues, especially as they relate to environmental remediation at federal facilities, by discussions with many individuals in advance of and in response to my testimony. Mark Schloneger provided invaluable research assistance for this Article, and my colleague, Brad Mank, provided numerous helpful comments.

While I frequently draw on my experiences with the Department of Energy's remediation of current and former Nuclear Weapons Complex sites (as chair of the Fernald Citizens Task Force and as a member of the Department of Energy's Environmental Management Advisory Board), the views that I express do not necessarily reflect those of the United States Department of Energy, the Fernald Citizens Task Force, or the Environmental Management Advisory Board.


risk, cost, and benefit in conjunction with major regulatory actions. More recently, an interagency group in the White House Office of Science and Technology Policy issued "Risk Principles" that adopt flexible guidelines for risk assessment, management, communication, and priority setting; thus far, only the Department of Energy has adopted these principles in toto. The United States Environmental Protection Agency (EPA) has also issued new risk assessment guidance with similar aims.

The risk assessment bills in the 104th Congress are legion. Some, such as House Bill 97 and Senate Bill 343, are wide-ranging regulatory reform efforts that seem deliberately designed to tie agencies in knots by imposing an almost endless array of analytical and procedural requirements, of which risk assessment is but one. Others, such as House Bill 1022 and Senate Bill 333, are limited to risk assessment

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4. See Exec. Order No. 12,866, supra note 3, §§ 3(f), 6(a); DEPARTMENT OF ENERGY, RISK ASSESSMENT, MANAGEMENT, AND COMMUNICATION AND PRIORITY SETTING (1995) [hereinafter RISK PRINCIPLES]. As they are not readily available elsewhere, the Risk Principles are included as an Appendix to this Article.

5. U.S. ENVTL. PROTECTION AGENCY, POLICY FOR RISK CHARACTERIZATION AT THE U.S. ENVIRONMENTAL PROTECTION AGENCY (1995) [hereinafter EPA POLICY]; SCIENCE POLICY COUNCIL, U.S. ENVTL. PROTECTION AGENCY, GUIDANCE FOR RISK CHARACTERIZATION (1995); U.S. ENVTL. PROTECTION AGENCY, IMPLEMENTATION PROGRAM FOR THE EPA POLICY ON RISK CHARACTERIZATION (1995); Memorandum from Carol M. Browner, Administrator, United States Environmental Protection Agency, to the Assistant Administrators, Associate Administrators, Regional Administrators, General Counsel, and Inspector General, United States Environmental Protection Agency (Mar. 21, 1995) (regarding the EPA risk characterization program) (on file with the University of Cincinnati Law Review).


7. H.R. 9. House Bill 9 is one part of the Republican’s “Contract with America.” Title III of the bill deals with risk assessment. Id. I discuss the version of title III that emerged from the Commerce Committee mark-up and that was thereafter severed from House Bill 9 and introduced as House Bill 1022.


9. H.R. 1022. As noted above, this bill originated as title III of House Bill 9, but was severed to make its passage easier.

10. S. 333. Senate Bill 333 is limited in scope to risk assessment and the environmental restoration activities of the Department of Energy. Id. § 4(a). It is modeled on legislation introduced by Senator Johnston in the 103d Congress. Senators Murkowski and Lott also proposed
and emphasize the careful use of limited resources. Taken together, these bills have several common elements that are the focus of this Article.\footnote{11. For clarity of exposition, I ignore several less important differences among the provisions of the various bills.}

All of the bills apply to two distinctly different agency functions: standard setting under specific programs and priority setting across programs. In the former, risk assessment is used to calibrate the breadth and stringency of particular regulatory actions. For example, risk assessment would be used to set acceptable emissions or clean-up levels. In the latter, risk assessment would determine the availability of resources and the sequence in which programs or actions would receive them.

Part I of this Article raises the concern that the content and procedural complexity of the mandated risk assessment process will result in lengthy, expensive, and inconclusive administrative standard setting. At the same time, none of the current proposals includes meaningful public participation in standard setting, robbing such decisions of depth and legitimacy. Part II argues that a purely risk-based system for setting priorities will lead to poor and even perverse priority-setting decisions. Risk is appropriately the starting point of much standard setting and priority setting for health-based environmental regulation, but other factors must have equal weight. Environmental problems affect all of us, and in a democratic society, it is the business of public policy, not of science, to decide how these problems should be handled. Part III draws an analogy between standardized academic tests and risk assessment, hoping to draw some lessons from testing’s long-established use of quantification. I conclude that standardized tests and risk assessment, like all good heuristics, tell us much, but do not tell us everything. In Part IV, I suggest that the real target of much of the risk legislation is the underlying environmental legislation. Whatever its value for other reasons, risk assessment is a poor way, and ultimately a dishonest way, to effect changes in the fundamental structure of environmental regulation. If reform of risk assessment practices is really the goal, the Clinton administration’s more flexible Risk Principles are a better model for legislation.

Throughout this Article, I draw on my experiences with the environmental remediation of a former nuclear weapons production facil-
ity, the Fernald Environmental Management Project, located in southwestern Ohio. Formerly the Feed Materials Production Center, Fernald was a uranium processing plant, and it represents one of the Department of Energy's major remedial efforts. In nearly four decades of operation, the facility severely contaminated the soil and groundwater on and adjacent to the site. The most recent estimate is that Fernald released one million pounds of uranium into the environment. Fernald is currently in the process of clean-up in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), and it illustrates the effects of the proposed risk legislation at an operational level.

Fernald also demonstrates the importance of public participation in risk assessment and environmental decision-making. The Fernald Citizens Task Force, which I chair, was established by the Department of Energy in 1993 as a "site-specific advisory board," charged with providing recommendations on four central remediation issues: the future use of the site, the degree of clean-up ("How clean is clean?"), waste disposition, and clean-up priorities. The Task Force consists of a diverse group of interested citizens ("stakeholders") in the area—residents, teachers, labor leaders, activists, health professionals, and local government officials—and works with the Department of Energy and its regulators, the EPA and the Ohio Environmental Protection Agency, to advise on these issues. By reaching consensus on these difficult questions and by contributing to an atmosphere of increasing openness and trust in the historically secretive and unaccountable nuclear weapons complex, the Task Force demonstrated that the public and government officials can work together to arrive at sensible, agreed upon solutions.

12. The six major sites are the Hanford Reservation, Washington; the Savannah River Site, South Carolina; Rocky Flats, Colorado; Oak Ridge, Tennessee; the Idaho National Laboratory, Idaho; and Fernald.


I. Risk-Based Standard Setting

The standard-setting provisions of the risk bills have five basic components. First, the applicability and content provisions require that risk assessments accompany most rulemaking and other regulatory actions. The bills establish a detailed template for risk assessments to follow, modeled on carcinogenic risk, and they insist that the assessments be "plausible" or "realistic" in the sense that all assumptions or extrapolations must be the most likely or "central" ones, as opposed to those that are extremely conservative or worst case. Second, the bills seek "transparency" in risk assessment by ensuring that all methodologies, assumptions, and estimates are identified and clearly explained to the user of the risk assessment. The Clinton administration's Risk Principles share the emphasis on transparency; however, the bills go further and require that worst-case estimates be presented only in conjunction with best-case estimates and that risks be communicated in the context of other risks, both similar environmental risks and "everyday" risks. Third, the bills impose a number of procedures for risk assessment, the most important of which is mandatory peer review, a review that in some cases can be the basis for requiring reassessment. A related requirement is a petition process for reopening any extant risk assessment, to which the agency must formally respond in a limited time period. Fourth, the bills provide for judicial review of risk as-

16. See S. 343 §§ 632, 634; Amend. No. 230, supra note 10, §§ 622, 628; S. 333 §§ 4(a), 6(a); H.R. 9 §§ 3013(b), 3201.
17. See S. 343 § 635; Amend. No. 230, supra note 10, § 625; S. 333 § 4(b); H.R. 9 § 3104(b).
18. See S. 343 §§ 631, 636; Amend. No. 230, supra note 10, § 623(3); S. 333 §§ 3, 4(b); H.R. 9 §§ 3102, 3104(a)-(b), 3107(3).
19. See S. 343 § 636; Amend. No. 230, supra note 10, § 626; S. 333 § 4(c); H.R. 9 § 3105.
20. Exec. Order No. 12,866, supra note 3, pts. B, D.
21. S. 343 § 636(3); S. 333 § 4(c)(3); H.R. 9 § 3105(3). Interestingly, a similar effort to circumvent the use of worst-case scenarios occurred in the context of environmental impact statements required by the National Environmental Policy Act, tit. I, § 102, 42 U.S.C. § 4332(C) (1988). The Reagan administration repealed the Council on Environmental Quality regulation requiring the use of a worst-case scenario for many of the reasons that current risk bills seek to require "central," as opposed to upper-bound, estimates. For a discussion on the reasons for the repeal, see 51 Fed. Reg. 15,620-24 (1986). The idea of comparing other risks, however, is new.
22. See Amend. No. 230, supra note 10, § 630; H.R. 1022 § 301; H.R. 9 §§ 3301-03.
23. See S. 333 § 5(b); H.R. 9 § 3401 (subject to judicial review).
assessments to determine compliance with the legislation, either separately or together with review of the regulatory action that they support. With respect to priority setting, the bills require agencies with environmental responsibilities to set explicit priorities among the programs and activities within their jurisdictions based on risk and cost, with the goal of achieving the greatest and most cost-effective risk reductions.

Fifth, the limited risk assessment bills purport not to replace the legal standards imposed by the underlying legislation, but House Bill 1022 and Senate Bill 343 add cost justification to those standards.

A. Avoiding Paralysis by Analysis

For all risk assessments, the bills adopt a model that was developed for carcinogens and reported in the 1983 National Academy of Sciences (NAS) "Red Book." While this methodology is obviously inappropriate for certain kinds of environmental harm, carcinogens have, in fact, dominated recent environmental regulation. In these statutes, human health risk is the dominant regulatory consideration, and many statutes adopt what can generically be called an "unreasonable risk" standard—a nonzero level of risk that is determined on an ad hoc basis by balancing health effects against other considerations such as available technology and cost. For these statutes, few realistic alternatives exist to using risk for environmental standard setting. Consequently,

25. See S. 343 § 639; S. 333 § 7(a)-(b); Amend. No. 230, supra note 10, § 629; H.R. 1022 § 601; H.R. 9 § 3501.
26. See S. 333 § 9(1); H.R. 9 § 3103(c).
27. See H.R. 1022 § 202(b).
28. See NAS RED BOOK, supra note 17, at 150-75; see also Howard Latin, Good Science, Bad Regulation, and Toxic Risk Assessment, 5 YALE J. ON REG. 89, 95-105 (1988) (evaluating the EPA's carcinogen guidelines); Sheila Jasanoff, Relating Risk Assessment and Risk Management: Complete Separation of the Two Processes Is a Misconception, EPA J., Jan.-Mar. 1993, at 35 (critiquing the "Red Book").
31. See Latin, supra note 28, at 95-105.
risk is a sensible starting point for analysis. The issue for standard setting, then, is not whether to use risk, but rather the degree of analysis that should be required. The bills require that a very substantial amount of data and analysis go into virtually all risk assessments, without consideration of the significance of the risk at issue, the amount of information that is readily obtainable, or the practical need for more information. I have noted elsewhere that the unreasonable risk standard inherently demands large amounts of data, much of which is unavailable. In fact, unreasonable risk encouraged the development of the quantitative risk assessment methodology to accommodate these demands, and the resultant scarcity of information needs to be addressed, either by generating more or by requiring less information. The risk assessment bills simply exacerbate the demands of the unreasonable risk standard, however, by requiring exhaustive risk assessments in all cases. Given the paucity of good risk data and the extremely high cost of obtaining it, the bills commit the government to lengthy and expensive regulatory analysis in virtually all cases.

Even if the requisite information were ultimately obtainable, the amount of data and analysis required should bear some relation to the significance of the decision being made. This is no more than a question of the cost-effectiveness of the analytical process itself: additional information should add value to—improve—the analysis. Like the diminishing marginal value of additional regulation, additional information becomes costlier and less marginally valuable. It is not only

32. Applegate, supra note 30, at 267-77.
33. Id. at 277.
34. See John S. Applegate, Worst Things First: Risk, Information, and Regulatory Structure in Toxic Substances Control, 9 YALE J. ON REG. 277, 309-28 (1992) (proposing a way to require less information in order to address the scarcity of information in risk assessment).
36. See Exec. Order No. 12,866, supra note 3, §§ 3(f), 6(a); RISK PRINCIPLES, supra note 4, at A.5; NATIONAL ACADEMY OF PUB. ADMIN., SETTING PRIORITIES, GETTING RESULTS: A NEW DIRECTION FOR THE ENVIRONMENTAL PROTECTION AGENCY 60-61, 66-67 (1995) [hereinafter NAPA].
37. The Risk Principles calibrate the amount of information with the significance of the decision. RISK PRINCIPLES, supra note 4, at A.5. Executive Order No. 12,866, like its predecessors, sets a threshold below which its analytical requirements do not apply. Exec. Order No. 12,866, supra note 3, §§ 3(f), 6(a).
38. See NATIONAL ACADEMY OF SCIENCES, supra note 35, at 207; COMMITTEE TO REVIEW RISK MANAGEMENT IN THE DEP'T OF ENERGY'S ENV'TL. REMEDIATION PROGRAM, NA-
possible, but likely that exhaustive risk assessments will not be justified in many cases. For example, removal (that is, temporary) actions to reduce threats to health and the environment at Superfund sites would not necessarily qualify as the emergencies that are exempted from many of the bills. Nevertheless, removal actions by definition respond to immediate hazards, and an elaborate risk analysis would add little to the ultimate decision to act.

To put it bluntly, the risk assessment portion of the bills should heed the advice of the priority-setting portions of the bills: resources should be used in a cost-effective manner. It would be ironic if legislation designed to improve the management of scarce resources mandated unwise use of those resources by demanding more analysis and less action. Even if one thinks that environmental regulations are often frivolous, there is no excuse for making them an expensive and time-consuming frivolity. CERCLA decision-making, for example, already takes too long and involves too many disputes, taking time and resources away from actual remediation. The people who live near environmental restoration sites like Fernald are understandably tired of seeing millions of dollars go into studies and analyses while on-the-ground remediation waits.

The petition process envisioned in the legislation would have a similarly inefficient effect. First, the ability to petition to revise already completed risk assessments (and to obtain judicial review of denial of such petitions) means that risk assessments would never be truly finished. More importantly, all regulation based on such risk assess-

39. See, e.g., S. 333 § 4(a)(2) (stating that the “Act does not apply to risk assessments or to risk characterizations performed with respect to . . . [a] situation that the Secretary determines to be an emergency”). An emergency is not required to trigger removal actions under CERCLA. See 42 U.S.C. § 9604(a) (1995) (granting the President the authority to act when there is a release or the threat of a release of a hazardous substance or pollutant into the environment); 40 C.F.R. § 300.415(b) (1994).

ments—in other words, virtually all environmental regulation—would always be up for review at the behest of a petitioner. For regulations of indefinite duration and at Superfund sites where work is expected to continue for several years, the right to petition creates enormous opportunities for delaying enforcement and actual remediation, respectively. Second, a petition process with deadlines for disposition distorts an agency's priorities by enabling interested individuals to dictate where administrative resources are directed. Once an individual files a petition, the agency must divert resources in response, resulting in a constant shifting of focus and loss of direction. Studies of the Occupational Safety and Health Administration (OSHA) and the Consumer Product Safety Commission have documented this effect and have concluded that their similar petition processes contribute to the agencies' ineffectiveness.41 Again, the bills exacerbate the problem that they purport to remedy.

Judicial review of risk assessments per se only makes the problem worse. The constant threat of judicial oversight would further encourage the analytical overkill of the bills' mandatory procedures. Elsewhere in environmental regulation, judicial review has frequently been cited as a cause for the "ossification" of rulemaking,42 that is, it exaggerates the existing tendency of any bureaucracy to make what is properly an analytical tool into an expensive and time-consuming end in itself.43 Agencies' fear of judicial reversal causes analysis to take on a life of its own, pursued to the logical, but not the practical, end.44 Even if courts were aware of the relative needs of big or complex decisions—as compared to the needs of small or obvious ones—and understood that, in some cases, information is simply absent, the bills would give the courts little latitude. The elements of the risk assessment are mandatory, and their quasi-procedural requirements are exactly what one would expect a court to enforce strictly.45


43. CERCLA's Hazard Ranking System for placing Superfund sites on the National Priorities List exemplifies this problem. See Applegate, supra note 42, at 223-26.


B. Assuring Public Participation

For all of the analytical framework and procedures established by the risk assessment bills, one procedure is almost entirely absent: the active involvement of the general public in developing the mandated risk assessments. This needs to be remedied. Members of the public can contribute ideas, concerns, and even information that will make risk assessments richer and more realistic. For example, the effects of a health hazard on certain subpopulations, or the distribution of risk throughout the population, may be far more apparent to lay citizens who are directly affected than to risk assessors in Washington, D.C. Similarly, citizens may have a degree of familiarity with an area or an activity that regulators lack and that the regulated community may be reluctant to address. More generally, the wisdom of obtaining a “second opinion” from nonexperts—which is at the heart of judicial review of agency action—acts as a hedge against the tunnel vision that can easily limit an expert agency’s perspective. Ultimately, public participation strengthens even controversial decisions by stimulating broader public understanding and acceptance. The mere incantation of expertise has long been rejected as an adequate basis for agency action.
Quantified, expert opinions of risk should be obtained and used, but they alone should not be decisive. Value questions cannot be avoided by claiming that risk assessments are simply scientific decisions.

The bills’ petition process and judicial review are not equivalent to public participation. They are designed for lawyers and consultants to mobilize full-scale technical assaults on risk assessments. Petitions and judicial review also necessarily extend the decision-making process, because they must be tacked onto the end of the decision-making process. In contrast, public participation is most useful at an early stage when it is most likely to play a constructive role in decision-making and before views have hardened into adversary positions. At its best, public participation provides the occasion for dialogue and teamwork during the decision-making process.

A useful example can be drawn from the Fernald clean-up project. Over the last several months, the Fernald Citizens Task Force has made a number of risk decisions that are unusual, if not unprecedented, in consistently recommending a degree of clean-up less than the maximum provided by law. The EPA interprets CERCLA to authorize a post-remediation risk level (that is, the level at which the risk is no longer unreasonable) of between $1 \times 10^{-4}$ (1 in 10,000) and $1 \times 10^{-6}$ (1 in 1,000,000) excess risk of cancer death. Under these standards, the Task Force could well have demanded the most rigorous level for clean-up of contaminated soil around Fernald. After a thorough investigation of the risk issues, however, the Task Force balanced the risk to persons who would come into contact with the contaminated soil against the severe disruption to the community that would be occasioned by removal of the productive top layer of soil, and it adopted a middle-ground clean-up target.

The Task Force’s choice between protection and disruption was clarified considerably by analyzing the risks and costs of remediation and the risk calculations for exposure to uranium-contaminated soil. Short-term disruption aside, it became clear that the highest level of protection would require the excavation of vast quantities of relatively “clean” soil. This choice would not only be expensive, but would also necessitate disposal of the soil elsewhere and would entail construction

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50. The distinction between lawyers, consultants, and “the public” is not, of course, very tidy. The practical distinction is between persons who participate as agents for others and are usually paid for their time and persons who participate purely on their own account.

51. These conclusions are reflected in Fernald Citizens Task Force, supra note 15.

risks to the remediation workers. Additionally, excavation posed the risk of disturbing contamination that was otherwise fairly immobile. Turning to the risk assessments, the exposure scenario for calculating the risk from the undisturbed soil was the so-called "resident farmer," a person who lives on the soil, works it, and consumes produce grown in it. The scenario is known colloquially as the "naked, dirt-eating farmer," however, because the model also assumes full-body exposure to the soil and incidental consumption of soil. Even though such individuals are a rarity in southwestern Ohio, the risk assessment was of value to our deliberations precisely because its conservatism provided a margin of safety for acceptance of a relatively higher level of residual contamination.

The Task Force undertook a similar analysis in determining the best way to handle contaminated soil and other debris from the clean-up. Specifically, the question was whether an on-site disposal facility should be used or whether the debris should be transported to more arid locations in the western United States. Fernald is far from an ideal place to store uranium-contaminated materials, because it lies over a sole-source drinking water aquifer. Permanent storage at Fernald entails an irreducible, though very small, risk of further contamination of the aquifer. The Task Force balanced the risks of a disposal facility against the transportation of large volumes of waste, considering the conservatism of the fate and transport models for the contaminants. This analysis convinced the group to opt for a balanced approach of shipping the highly contaminated, low-volume waste and keeping on site the slightly contaminated, high-volume waste.

C. Transparency

The Fernald example suggests that what is needed in risk assessment legislation is not pinpoint accuracy or elaborate procedures, but rather clear exposition of what is known about the risks at issue—"transparency." Thus, the requirement in the bills that all assumptions, models, and extrapolations be fully explained and that their use be justified makes eminently good sense. Requiring such explanations is a good way to ensure continuing attention by experts. Moreover, it guards against the systematic underestimation of risks by per-
sions familiar with an activity. Thus, it is also the foundation of public participation: without full understanding, it is difficult or impossible for citizens to make meaningful comments.

The bills go beyond transparency, however, in requiring “best estimates” and “realistic” or “central” assumptions. Assumptions and estimates are, of course, of critical importance to the entire enterprise because of the great uncertainty that surrounds risk assessments, especially those involving carcinogens. The sources of uncertainty are legion, and the results of risk assessments usually depend on the way that the uncertainties are resolved. The bills are correct to recognize uncertainty as a central issue in risk assessment, and there is, in truth, little reason not to move away from extreme or counterfactual scenarios.

Two caveats are in order, however. First, scientific certainty cannot be legislated. Congress cannot create definite answers simply by requiring risk assessors to use, for example, the “central” or most “realistic” value in a range of possible values. The central value is not necessarily the “right” or even the most probable one. Likewise, currently “realistic” scenarios do not necessarily account for future exposure scenarios, and typical or representative scenarios do not account for those individuals who are exposed at atypical levels. Unless we are prepared to ignore future users of a contaminated site or highly exposed individuals, it would be a mistake to rule out scenarios and assumptions simply because they do not reflect current conditions.

Oddly, the bills themselves contain provisions for expressing risk as a range of values, presumably because their authors recognize that in many cases there is no one “objective” scenario. This contradicts the idea of demanding a single “realistic” number, but it is the more sensible approach and more consistent with the goal of transparency. A range or even a noncentral value can be thoroughly explained in a risk assessment, leaving the user of the risk assessment with a fuller understanding of the issues and in a better position to make judgments. In this way, risk assessments can truly focus and inform public discussion.


56. For example, the D.C. Circuit recently overturned an EPA regulation based on a risk assessment that assumed that a child was living on a highway median strip for five years, eating soil the entire time. Leather Indus., Inc. v. EPA, 40 F.3d 392, 404-05 (D.C. Cir. 1994).

57. See Leiss & Chociolko, supra note 55, at 140-44 (criticizing as unrealistic the idealization of science as a policy tool separate from values and socio-economic context).

58. See Arlene Yang, Student Article, Standards and Uncertainty in Risk Assessment, 3 N.Y.U. Env'tl. L.J. 523 (1995) (arguing that guidelines should focus the uncertainty and policy
Second, there is nothing inherently wrong with choosing conservative or protective scenarios or assumptions. After all, environmental legislation has at its heart the prevention of harm before it occurs. This certainly implies erring on the side of safety when uncertainty exists. If an estimate turns out to be erroneous, surely we would rather be in the position of relaxing unneeded restrictions than apologizing to victims' families. In any event, as the Fernald example demonstrates, even an extremely conservative risk assessment, if fully explained, can be used intelligently.

In sum, transparency is essential to good risk assessment and risk communication, but it must go beyond one-way communication from technical risk assessors and decision-makers, with the meaningful input limited to regulated entities, their risk assessors, and their lawyers. This is no easy task, as a growing literature on risk communication documents. Transparency requirements are the necessary foundation for two-way communication between government and the public it serves. Risk assessment should not simply be ammunition for opponents of regulation; rather, it should encourage better understanding of all of the true costs and benefits of environmental protection.

II. RISK-BASED PRIORITY SETTING

The government does not have the information or resources needed to move forward simultaneously against all of the environmental threats that legislation targets. Consequently, action on some items must be deferred or limited in scope. The actual gap between resources and problems may be smaller than many imagine, and there
debate surrounding risk issues, not attempt to resolve them).

59. See, e.g., Ethyl Corp. v. EPA, 541 F.2d 1, 13-28 (D.C. Cir.) (en banc) (finding that Congress intended a Clean Air Act provision to be precautionary in nature and, thus, not to require proof of actual harm before regulating), cert. denied, 426 U.S. 941 (1976); see also Adam Finkel, A Second Opinion on an Environmental Misdiagnosis: The Risky Prescriptions of Breaking the Vicious Circle, 3 N.Y.U. Envtl. L.J. 295 (1995) (discussing Stephen Breyer's Breaking the Vicious Circle and arguing that a "better safe than sorry" policy is best).


61. Risk Principles, supra note 4, at D.1 (stating that "[r]isk communication should involve the open, two-way exchange of information between professionals, including policymakers and 'experts' in relevant disciplines, and the public").

62. See generally Applegate, supra note 34, at 304-28 (proposing that the EPA should restructure its regulatory scheme to emphasize more thoughtful priority setting because of the scarcity of information and resources).

63. See California Comparative Risk Project, Toward the 21st Century: Planning for the Protection of California's Environment 41-43 (1994) (summary report) (recommending that policy makers fully and explicitly analyze the economic trade-offs of
are many useful steps that we can take to narrow this gap. For example, cause-based regulation, questioning the necessity of certain goods and activities, and better information development would all improve the ratio of resources to problems. Nevertheless, the problem of scarcity remains. Given the stakes involved, purely subjective or intuitive risk evaluations are inappropriate. An agency that lacks a deliberate planning and priority-setting process will simply respond to the crisis *du jour* and will drift, squander its resources, and ultimately accomplish little.

Considered priority setting, therefore, is both inevitable and desirable. The difficulty is in choosing the criteria to use. To set priorities in other than an ad hoc fashion requires some common measure or set of measures. (Ultimately, of course, priorities are expressed in the common measure of budget dollars.) Risk suggests itself as such a measure, both because of its intrinsic importance to environmental issues and because of its legal importance in the relevant statutes.

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65. O'Brien, supra note 63, at 99-100.

66. See Lyndon, supra note 35, at 1835-61 (suggesting that toxicity data collection and management should be administered by principles that will promote a national data system).

67. See O'Brien, supra note 63, at 102.


69. Merrill, supra note 41, at 1363-64 (contending that the attention given to petitions distorts the Consumer Product Safety Commission's judgments); Shapiro & McGarity, supra note 40, at 18-20 (asserting that OSHA needs a formal priority-setting process or else it will always be subject to the priorities of others); Bartman, supra note 41, at 118.

70. See Richard N.L. Andrews, *Long-Range Planning in Environmental and Health Regulatory Agencies*, 20 Ecology L.Q. 515, 532 (1993); Applegate, supra note 34, at 283-89 (contending that, because of the scarcity of resources, the EPA must carefully determine priority setting); NAPA, supra note 36, at 121-22, 158-62 (focusing on internal management concerns).

71. See *Should We Set Priorities Based on Risk Analysis?*, EPA J., Mar.-Apr. 1991, at 18 (section by Daniel P. Moynihan) (asserting that prioritizing environmental problems is "common sense"); id. at 20 (section by J. Roy Rowland) (asserting that "risk assessment is more than a useful tool; it is unavoidable").
the proposed risk legislation provides that human health risk, in connection with cost, shall be the basis for allocating resources. That is, the agency is expected to maximize risk reduction by choosing the most cost-effective ways to reduce risk.

The use of risk in setting regulatory priorities has, as one would expect, many of the same weaknesses that it does for setting standards. To some, using risk to make judgments across numerous programs—that is, comparing risks—simply magnifies those weaknesses and renders it entirely inappropriate for such use. I disagree. Even if the gaps and weaknesses in risk assessment suggest that it is disturbingly imprecise for standard setting, it can still be useful for setting priorities, which need not require a high degree of accuracy. Risk analysis is useful for organizing relevant information, and it is a good place to begin when comparing programs and activities. However, for two broad reasons, risk analysis must be used in conjunction with other considerations: risk has severe limitations as a common measure, and other factors are equally important.

A. Risk and Its Limitations

Risk is an imperfect expression of the degree of concern that should attach to a particular environmental problem. As an initial matter, the basic data needed to perform risk evaluations of chemicals, activities, and sites are severely limited, and the uncertainties in the extant data are profound. For example, when ranges of possible values are taken into account, risk rankings can even be reversed. It may be possible

72. See Applegate, supra note 42, at 233-34; Applegate, supra note 34, at 324-28. OSHA and the EPA originally consigned quantitative risk assessment only for priority setting, because it was insufficiently accurate for standard setting. Id. at 326. It was not the agencies, but the Supreme Court, see Industrial Union Dep't, AFL-CIO v. American Petroleum Inst. (Benzene), 448 U.S. 607 (1980), that made quantification part of standard setting. See Applegate, supra note 30, at 283.

73. See California Comparative Risk Project, supra note 63, at 22-23 (breaking risks into high, medium, and low categories); Jasanoff, supra note 28, at 37 (“Risk assessment does indeed offer a principled way of organizing what we know about the world. . . .”); NAPA, supra note 36, at 58.

74. Finkel, supra note 59, at 295; see also National Academy of Sciences, supra note 35, at 205-208; id. at 205 (“The information available . . . is scanty, and the resources . . . do not suffice to test all chemicals for every possible health effect.”); Office of Technology Assessment, Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production 62-64 (1991) (asserting that credible data needed for evaluation has not been attained); McCloskey Speech, supra note 63, at 1-2 (stating that substantial gaps exist in the data necessary to apply the methodology to noncarcinogens); Shapiro & McGarity, supra note 40, at 5.

75. Adam M. Finkel, Some Small Steps for Congress, Some Giant Leaps—Backwards—for Risk Assessment?: Testimony Before the Subcommittee on Environ-
to make better use of data or to make more realistic assumptions to
cover the uncertainties, but the gaps and uncertainties remain and can-
not be eliminated by legislation. 76 Similarly, estimating long-term risks
is so difficult that the results are necessarily highly subjective. 77

Furthermore, risk has many meanings, and disaggregating them is
crucial. 78 Even within the purview of human health, there are many
possible endpoints. Risk assessment today focuses on cancer deaths and
sometimes on teratogenicity, but many other injuries occur—noncancer
deaths, cancer that does not directly cause death, breathing difficulties,
and others ad infinitum. 79 Also, occupationally encountered risks may
well be viewed differently from others, partly because workers volontu-
arily encounter such risks in return for wages. 80 Conversely, the protec-
tive standards of existing legislation suggest that, as far as the general
public is concerned, our policy is to be highly risk averse. 81 Indeed, the
tendency to focus more on the severity of the possible consequence than
on the relative likelihood of its occurrence is strong. 82 This may be
simply because catastrophe is more easily understood than is incremen-
tal risk. However, it is hardly irrational to fear and to protect against
catastrophic injury.

76. For suggestions on how better to address uncertainty in risk assessment, see Applegate, supra note 42, at 231-35 (arguing that CERCLA has created a misallocation of resources and suggesting reform); Latin, supra note 28, at 134-48 (recommended that social policy criteria influence agency choices in risk assessment); Lyndon, supra note 35, at 1841-61 (suggesting improvements in data collection and recommending a national data system to reduce uncertain-
ties); Symposium, Setting Environmental Priorities: The Debate About Risk, EPA J., Mar.-Apr. 1991, at 17 [hereinafter Setting Environmental Priorities]; Finkel, supra note 75, at 6 (recommending that agencies focus on what actions would best address the causes of risks in- stead of determining which risks are the worst).

77. See J. Christopher Noah, Environmental Ethics and the Future Use of Weapons Fa-
cilities, 1994 FED. FACILITIES ENVTL. L.J. 349, 352 (stating that “since environmental values are subjective, they cannot be prioritized by humans”); Raymond Loehr, What Raised the Is-
ue?, EPA J., Mar.-Apr. 1991, at 6, 8 (stating that “without more and better data, conclusions about relative risks will be tenuous and will depend in large measure on professional judgment”).

78. See RISK PRINCIPLES, supra note 4, at E.2 (“Programs should set priorities in manag-
ing risks.”); Donald T. Hornstein, Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis, 92 COLUM. L. REV. 562, 587-92 (1992) (stating that because indi-
viduals confront risks in different ways, there is a need for theoretical guidance).

79. See CALIFORNIA COMPARATIVE RISK PROJECT, supra note 63, at 14; Should We Set Priorities Based on Risk Analysis?, supra note 71, at 19 (section by Jonathan Lash).

80. See CALIFORNIA COMPARATIVE RISK PROJECT, supra note 63, at 34.

81. See Hornstein, supra note 78, at 592-604 (noting that by emphasizing aggregate risk, comparative risk assessment ignores distribution of risks and specially affected subpopulations).

82. See Terry Davies, Remarks at the Conference on Environmental Risk Assessment, Politics, and Policymaking (Nov. 3, 1994) [hereinafter Davies Speech].
The technical problem with risk-based priorities is that no good methodology exists for comparing different types of risk. For example, the simple choice of a road-paving material implicates the comparison of many disparate risks: the relative safety to drivers as compared with other surfaces that are more slippery or that contrast less well with lane markings, fumes from the material that are toxic to workers, fumes that are toxic to drivers, risk of accidents to workers resulting from materials that need frequent replacement, and lesser risks to the environment from materials that include recycled components. Assuming that trade-offs are necessary, which risks should be encountered and which should be avoided? Similarly, it is hard to see how one could compare, in a single, objectively verifiable, "scientific" way, risks as disparate as cancer caused by an industrial chemical, traffic accidents, destruction of an ecosystem, workplace accidents, birth defects, and AIDS. I will not belabor the enormous technical and conceptual difficulties of comparing risks, other than to point out that those who have actually attempted thorough and systematic comparisons of risks have expressly disclaimed any strictly scientific or objective methodology for making such comparisons.

B. Nonrisk Criteria

The foregoing considerations are not fatal to risk-based priority setting, but they do mean that we must be modest in our expectations for its accuracy and that we must look to other considerations as well.


84. For discussions of the difficulties of comparing risks, see Hornstein, supra note 78; Setting Environmental Priorities, supra note 76, at 17-39.

85. Actual efforts to compare risks also speak of the difficulties of the enterprise. For examples of efforts to compare risks, see CALIFORNIA COMPARATIVE RISK PROJECT, supra note 63; EPA SCIENCE ADVISORY BD., REDUCING RISK: SETTING PRIORITIES AND STRATEGIES FOR ENVIRONMENTAL PROTECTION (1990); ENVIRONMENTAL PROTECTION AGENCY, UNFINISHED BUSINESS: A COMPARATIVE ASSESSMENT OF ENVIRONMENTAL PROBLEMS (1987) [hereinafter UNFINISHED BUSINESS].

86. Cf. California v. Watt, 668 F.2d 1290, 1325 (D.C. Cir. 1981) (holding that, although the comparison would not be perfect, the Secretary of the Interior was required to compare effects on fisheries in different regions).

87. See RISK PRINCIPLES, supra note 4, at E.2 (noting that risk assessors should take into account different kinds of risks, the feasibility of reducing or avoiding risks, quality of life, environmental justice, and risk distribution); NAS RED BOOK, supra note 17, at 49 ("Risk assessment is only one aspect of the process of regulatory control of hazardous substances."); Richard A. Merrill, Federal Regulation of Cancer-Causing Chemicals, in ADMINISTRATIVE CONFERENCE OF THE UNITED STATES: RECOMMENDATIONS AND REPORTS 1982, at 21 (1982) (stating that because of the limitations on risk assessment, risk estimates are only one considera-
The criteria other than risk that are relevant to priority setting can be divided into two groups: public values and administrative concerns.

With respect to public values, Ken Jones has observed:

[...]

One has only to look at the text of federal environmental statutes to confirm that human health risk is not the only goal that they serve and that, by and large, the statutes do not exclude nonrisk considerations in setting standards. CERCLA, for example, requires remedial actions to be “protective of human health and the environment,” as does virtually every other major environmental statute. Ecosystem damage is not only an entirely different type of risk than human health risk, but it also implicates other important values on its own terms, either from a respect for nature or for pure uniqueness.

Take, for example, the saguaro cactus of Arizona. This giant, vaguely anthropomorphic archetype of American cacti is threatened by its own popularity—people want it in their backyards and are willing to pay good money for it. Saguaro cacti, therefore, have a readily determinable market value. Saguaro National Monument, near Tucson, consists of rugged, arid valleys of saguaros stretching as far as the eye can see. It would be a simple matter to estimate the number of cacti in the Saguaro National Monument to come up with a fair market value for them. Of course, such an exercise would be meaningless, even silly.

The breathtaking number of saguaros collected in one place of striking beauty gives the Monument's cacti a value that is beyond price. Whether or not we can discern some long-term, tangible, human benefit from natural resources and ecosystems, their protection is firmly embedded in our environmental law, and I would be very surprised if the American people were prepared to retreat substantially from that commitment.

Similarly, cultural and historical values may inform our understanding of what is "worst" in a given situation. At the Department of Energy's Hanford site in eastern Washington State, contamination of the soil and groundwater put Native Americans at risk from their religious use of parts of the site. The historical lack of concern for Native American traditions and current cultural concerns would fully justify placing restoration of such areas relatively high on a list of priorities.\textsuperscript{90} Even if they are not a dominant factor, the relatively amorphous concerns of quality of life and public anxiety also ought to be considered.\textsuperscript{91} Emotional distress is often the major item of damages in a toxic tort suit,\textsuperscript{92} and anxiety may be the day-to-day effect of unremedied environmental risks.

Likewise, culpability is relevant to the priority of a particular activity. Using the Department of Energy as an example, the fundamental wrongness of a secretive and unaccountable government agency's poisoning the environment and putting at risk the health of the people whom it was supposed to serve creates a moral imperative for remedial action that is not captured by risk assessment alone. Indeed, Congress' enormous financial commitment to environmental restoration at federal facilities reflects precisely this sense of outrage, wholly apart from relative risk.\textsuperscript{93}

Perhaps the most important value that is likely to be encountered is equity, or the distribution of risks. As the environmental justice movement has made clear, risks are not distributed evenly across the population. Wealth, race, neighborhood, advanced age, and infancy can all

\textsuperscript{90} Tribal concerns at Hanford are eloquently described in \textit{Confederated Tribes of the Umatilla Indian Reservation, Scoping Report: Nuclear Risks in Tribal Communities} (1995).

\textsuperscript{91} See \textit{California Comparative Risk Project}, supra note 63, at 33-36 (examining the impact of environmental problems on "social welfare"); see also David L. Markell, \textit{States as Innovators: It's Time for a New Look to Our "Laboratories of Democracy" in the Effort to Improve Our Approach to Environmental Regulation}, \textit{58 Alb. L. Rev.} 347, 379 (1994) (noting that public interest per se is one of the state's priority-setting criteria).


make significant differences in susceptibility and exposure. We cannot completely characterize health risks for priorities or standard setting without accounting for specially impacted subpopulations, “hot spots” of multiple exposure, highly exposed persons,44 or even identifiable individuals.45 Distribution may be unequal across time as well—what we put off today, we impose on our children—so that intergenerational equity must be a concern.46 Intergenerational responsibility creates a moral mandate to address problems that are modest now, but that will worsen significantly over time.

Turning to administrative criteria, Adam Finkel has observed that the issue is not which risks to address first, but which actions to take first.47 From that perspective, a thoughtful decision-maker would consider cost-effectiveness and a variety of administrative issues, in addition to risk. If most of the needed information is either available or easily obtainable, there is every reason to move forward without delay, because resources need not be diverted to further study and assessment.48 By the same token, there is little reason to defer, on risk grounds, actions that are inexpensive in absolute terms or that can be implemented with minimal disruption.49 The tractability of a problem100 and the administrability of the remedy101 also ought to be

94. See OFFICE OF TECHNOLOGY ASSESSMENT, supra note 74, at 63 (criticizing the Department of Energy’s assessment plan, because it failed to consider multiple contaminants or to identify the “most exposed individual”); Hornstein, supra note 78, at 592-95 (criticizing “hard” risk assessments that only evaluate how many people will suffer).

95. See Davies Speech, supra note 82.

96. EDITH B. WEISS, IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY 5-45 (1989) (describing the planet as a “global commons” shared by all generations and contending that the law should reflect this viewpoint); Noah, supra note 77, at 352 (“[E]nvironmental destruction could be eliminating some currently unknown but future economic asset.”).

97. See Finkel, supra note 75, at 6 (“[W]hat actions should we take right away? is the practical question we need to ask in a time of resource constraints.”).

98. See Bartman, supra note 41, at 115-20.

99. O’Brien, supra note 63, at 99-100 (positing that society needs to consider the “essentiality of products, product specifications, and public programs that are environmentally degrading”).

100. See Noah, supra note 77, at 352 (“[I]nstitutional problems associated with managing the environment are much more intractable than scientific and technological problems.”); Adam Finkel, Do We Know Enough to Take a Risk-Based Approach?, EPA J., Mar.-Apr. 1991, at 38, 38 (“[T]he most sophisticated ranking of risks and benefits will be a vain exercise unless EPA is committed to controlling even the small risks when the solution is cheap or economically beneficial and dedicated to searching for new ways to ameliorate what seem to be large but intractable risks.”).

101. Mark E. Shere, The Myth of Meaningful Environmental Risk Assessment, 19 HARV. ENVTL. L. REV. 409, 478-79 (1995); see also Merrill, supra note 87, at 114-17 (“Agencies should not shrink from contested proceedings when health risks are high, but they should consider their ability to enforce any formal limit they set.”).
considered.

In most situations, it would make the most sense to address risks that can be significantly mitigated within a reasonable period of time. This imparts an important sense of accomplishment, and it relieves the need for further attention to the problem. Risk assessments aside, one should be loath to commit to a lengthy, quixotic environmental restoration effort. Finally, an environmental regulator should always be on the lookout for fundamental changes in processes or products that would remedy several environmental problems at once or that would anticipate and prevent problems, even if conventional risk assessment suggests a low-ranking risk.

The interplay of risk and nonrisk considerations can be seen in the recommendations of the Fernald Citizens Task Force regarding the plume of contaminated groundwater extending from the Fernald property. The Great Miami Aquifer is a major source of drinking water in southwestern Ohio, and activism at Fernald was born when the news broke that drinking water wells were contaminated with uranium. The immediate groundwater risk was avoided relatively easily by providing bottled water to residents and, ultimately, by installing water lines. Nevertheless, the contamination of the aquifer remains the single greatest source of concern to Fernald’s neighbors, for several good reasons. First, contamination of groundwater goes to the heart of people’s sense of well-being. It is nourishment, and it comes into intimate contact with the body. Access to potable groundwater is considered an integral part of land ownership.

Second, this huge aquifer is a major natural resource of the State of

102. See generally Mary R. English, Can Risk Assessment and Risk Prioritization Be Extricated from Risk Management?, in RISK ASSESSMENT IN SETTING NATIONAL PRIORITIES 495, 495-500 (1989) (noting that because uncertainty and inequity cause difficult problems in risk assessments, they should be a part of risk priority-setting and management choices).

103. See Hornstein, supra note 64, at 405-06 (articulating a “cause-oriented approach” to environmental law reform that would focus on incentives to cause environmental problems and the role that disincentives could play in solving them); Goldstein, supra note 44, at 23 (“While continuing to emphasize risk assessment as a means to prioritize the approach to existing problems, EPA needs to assign a high level of priority to the much more cost-effective approach of anticipating and preventing new environmental problems.”); NAPA, supra note 36, at 29 (prevention); Thomas Eisner et al., Building a Scientifically Sound Policy for Protecting Endangered Species, 268 SCIENCE 1231, 1232 (1995).

Ohio. Natural resources *quá* natural resources are valuable in themselves and, indeed, resist valuation.\textsuperscript{105} While a single instance of contamination may not, in itself, destroy the resource, the multiplication of insults surely will. Any serious conception of stewardship of natural resources demands a response.\textsuperscript{106}

Third, to do nothing to remediate the contamination is to leave a far bigger problem to future generations, because the uranium plume will spread over time.\textsuperscript{107} Thomas Paine said, in a different context: "Every age and generation must be as free to act for itself, in all cases, as the ages and generation which preceded it. The vanity and presumption of governing beyond the grave is the most ridiculous and insolent of all tyrannies."\textsuperscript{108} For people who have lived in the Fernald area for generations, this obligation to the future is by no means hypothetical.

Yet the Task Force did not recommend that the aquifer be cleaned up to the original background (naturally occurring) level of uranium, but instead adopted a middle-ground position (approximately $10^{-5}$ excess cancer risk). The long-term risks and costs of doing nothing were evaluated and were found to be unacceptable. However, the maximum clean-up was considered to be of questionable technological feasibility in view of the extremely low concentrations of uranium that would be involved. The maximum clean-up was also viewed as unmanageable, because it would require pumping and treating of the plume for several decades. Choosing a remedy that could be completed in the foreseeable future and within the useful life of a single treatment plant was preferable. The middle ground recommendation was a good and a stable one. It realistically weighed a variety of risk and nonrisk factors, including values and administrability. By working with the public to reach this decision, the Department of Energy and its regulators achieved substantial risk reduction at reasonable cost. They also won the support of their stakeholders, making it easier to reach consensus.

\begin{itemize}
  \item \textsuperscript{105} However, CERCLA, 42 U.S.C. §§ 9601-9675 (1988), attempted to value natural resources damages. These damages have been hotly contested. See Ohio v. Department of Interior, 880 F.2d 432 (D.C. Cir. 1989).
  \item \textsuperscript{106} The idea of stewardship is reflected in the public trust doctrine, which had some currency in the 1970s, but apart from the natural resources damages provisions of CERCLA, has been quiescent recently. For an informative discussion of the public trust doctrine, see ENVIRONMENTAL LAW AND POLICY: NATURE, LAW AND SOCIETY 365-412 (Zygmunt J.B. Plater et al. eds., 1992).
  \item \textsuperscript{107} See Noah, supra note 77, at 352 ("[W]e must maintain ecosystem unity to maintain humanity in the long run."). See generally Weiss, supra note 96, at 5-45 (describing the planet as a "global commons" shared by all generations and contending that the law should reflect this viewpoint).
  \item \textsuperscript{108} THOMAS PAINE, Rights of Man, in COMMON SENSE AND OTHER POLITICAL WRITINGS 73, 76 (Nelson F. Adkins ed., 1953).
\end{itemize}
C. Public Involvement

The risk assessment bills provide no more public input into priority setting than they do for risk assessment. This is an unnecessary and unwise exclusion.\textsuperscript{109} Studies that have compared public and expert evaluation of risks have uniformly found striking differences between these groups' perceptions of the seriousness of the same risks.\textsuperscript{110} These differences highlight the importance of nonrisk considerations in priority setting. While some of the differences can be dismissed as public misperceptions of risk,\textsuperscript{111} their true significance is that the public and the experts are looking at very different things.\textsuperscript{112} (People also have inconsistent preferences, which is a subject of economics and public choice theory.\textsuperscript{113}) Since risk itself can mean many things, this is hardly surprising. Priority setting, as much as anything that regulators do, expresses basic values. Risk can and should inform the expression of those values in the allocation of resources, but as Donald Hornstein has said, risk should not replace values.\textsuperscript{114} Moreover, it is contrary to our traditions to elevate the judgment of a technocratic elite above that

\textsuperscript{109} The Risk Principles include public input for setting priorities. \textit{Risk Principles}, supra note 4, at E.3. (asserting that priority setting “should be informed by internal agency experts and a broad range of individuals in state and local government, industry, academia, and nongovernmental organizations, as well as the public at large”); \textit{see also Building Consensus}, supra note 38, at 35-37 (recommending public participation in risk assessment and risk management).

\textsuperscript{110} In addition to the EPA studies referenced above, Justice Breyer’s book documents this phenomenon. \textit{See Breyer}, supra note 60.

\textsuperscript{111} \textit{See id} at 33-39 (finding that public perception about risks is often irrational); Bruce N. Ames & Lois S. Gold, \textit{Environmental Pollution and Cancer: Some Misconceptions, in Phantom Risk: Scientific Inference and the Law} 153, 153-81 (Kenneth R. Foster et al. eds., 1993) (documenting public misconceptions about the relationship between environmental pollution and cancer); Paul Slovic, \textit{Perception of Risk}, 235 \textit{Science} 280, 280 (1988); Cross, \textit{supra note 65, at 949-55 (urging a limited role for the public)}.


\textsuperscript{113} \textit{See EPA Science Advisory Bd., supra note 85, at 11}; Donald T. Hornstein, \textit{Paradigms, Process and Politics: Risks and Regulatory Design, in Worst Things First? The Debate over Risk-Based National Environmental Priorities}, supra note 63, at 147, 155 (describing a “republican moments” concept where environmental statutes are enacted not during “normal” political periods, but during periods when the population becomes intensely interested in environmental issues, such as Earth Day and the Love Canal episode). For a discussion on the public choice theory and legal issues, see \textit{Daniel A. Farber & Philip P. Frickey, Law and the Public Choice} (1991).

\textsuperscript{114} \textit{See Hornstein, supra note 78, at 587 (“[D]ecision theories need to connect the values underlying environmental disputes with the problems presented to decisionmakers.”).
of the public at large, even in the name of efficiency or cost-effectiveness. Values and political choices cannot be avoided in setting priorities, and we cannot evade responsibility for value judgments by claiming that priority setting is merely science.\textsuperscript{116}

In the end, after full information and careful consideration, a disjunction may remain between the risk ranking of the public and that of the scientists.\textsuperscript{116} Some see mischief in this mismatch,\textsuperscript{117} but I do not. A democratic government must be ready to account for the public view of risks.\textsuperscript{116} If the public misunderstands the issues, the governmental obligation is to educate and to persuade, not to ignore or to legislate irrelevance. It makes sense to begin with risk experts in setting priorities, but the process should not end there: the public needs to be as much a part of setting priorities as of setting standards. The risk assessment bills are right to begin with health risk, but wrong to end with it.

III. Lessons from the LSAT

To anyone involved in higher education, many of the concerns about quantitative risk assessment and comparative risk assessment have a familiar ring. The Law School Admissions Test (LSAT), Scholastic Aptitude Test (SAT), and other standardized tests similarly seek to establish a metric—a "common yardstick," as one College Board publication puts it\textsuperscript{119}—against which applicants can be evaluated and com-

\textsuperscript{115} See Andrews, supra note 70, at 536-37 (arguing that the most effective anticipatory planning option would require consideration of public policy); Harold P. Green, The Role of Congress in Risk Management, 16 Env. L. Rep. 10,220, 10,220 (1986) (stating that "[r]isk management by Congress is more [a] political than a scientific . . . exercise"); Hornstein, supra note 64, at 378-79 (asserting that the "measurement of risk cannot be separated from value judgments in risk assessment methodologies"); Hornstein, supra note 78, at 593 ("That decisionmakers might plausibly reach different evaluations of environmental risks raises what I take to be an important attribute of environmental law: it must be able to define and reflect our values . . . ."); Latin, supra note 28, at 126 (noting that the perception that every step toward "good science" is justified despite its possible effect on protection is "surely a public policy issue rather than a purely scientific question"); NAPA, supra note 36, at 142-44; Leiss & Chociolko, supra note 55, at 140-44.


\textsuperscript{117} See Breyer, supra note 60, at 33-39 (finding that the public's failings and media prominence give a very inaccurate view on risks, especially through overestimation and extrapolation of unusual events); Ames & Gold, supra note 111, at 1530-79 (describing how scientific evidence undermines eight "misconceptions" that the public has about environmental pollution and cancer); Cross, supra note 65, at 949-55 (urging a limited role for the public).

\textsuperscript{118} Durenberger, supra note 63, at 50-51 (arguing that risk assessment may be valuable, but that it is no substitute for attention to the public's values).

\textsuperscript{119} See Robert G. Cameron, The Common Yardstick: A Case for the SAT
Many regard such quantification with suspicion, and not without some justification: quantifying a nonnumerical quality like "aptitude" is an oversimplification that excludes other aspects of the individual. Moreover, numbers have a persuasive power, perceived precision, and resultant authority that can obscure underlying uncertainty or variation. On the other hand, quantification survives and even thrives. The LSAT can be used both as an "indicator of certain mental abilities related to academic performance in law school" and as a tool for comparing and ranking students. Especially in combination with the undergraduate grade point average, the LSAT correlates with success in the first year of law school. While this is not the only endpoint one might choose, it is at least relevant to admissions decisions. The standardized test is an efficient and readily understandable means of expressing certain ideas or concepts. More importantly, it provides a uniform standard for the core task of selecting among highly diverse individuals, which itself provides a kind of equity.

I do not want to overstate the analogy to risk assessment or to comment on the underlying question of the validity of standardized testing. Nevertheless, some familiar principles for the proper management of LSAT scores might tell us something about the proper use of risk assessment.

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(1989).


122. Id. at 3.4-3.5. Law School Admissions Services (LSAS) considers nonadmissions use (for example, employment use) to be inappropriate. Id. at A.2. Appendix A of the Reference Manual is also published as a separate pamphlet. Law Sch. Admission Council/Law Sch. Admissions Servs., Cautionary Policies Concerning LSAT Scores and Related Services (1993).

123. First-year success is used instead of law school success and success as a lawyer, because it is much more easily measurable and less confounded by other factors. There is an analogy here to the use in the risk assessment bills of human health risk, which is only one of several potentially relevant endpoints.

124. See Reference Manual, supra note 121, at 3.4-3.5; Jonathan Rowe, A Tale of Two Tests: SAT v. LSAT, Christian Sci. Monitor, July 27, 1987, at 21 ("[T]he LSAT says less about an applicant's ability than about the need of law schools to winnow mountains of applications. It's somewhat arbitrary, but 'better than throwing them down the stairs' and selecting the ones at the bottom.").

The main lessons from the LSAT are the importance of understanding its limitations and the need to use the test results in conjunction with other measures. Without these qualifications, use of the test is likely to be misleading. It would certainly be possible—easy, in fact—simply to admit students to law school in rank order of LSAT score. Clearly, no one would find such a process to be adequate; admissions professionals would regard it as essentially malpractice. Even adding the undergraduate grade point average into the formula, thereby improving prediction of first-year grades over the use of the LSAT alone, would be unduly mechanical, for reasons that parallel the concerns about using only risk or only risk and cost to set environmental standards and priorities.

Also, there is uncertainty in the LSAT's measurement of the likelihood of success in the first year of law school (although not in the range of orders of magnitude, like risk assessment). The LSAT has a standard deviation of approximately 3 points on a 120-180 scale. Thus, the difference between, say, a 150 and a 152 is not statistically significant and should not be the sole basis for making admissions decisions. This inherent uncertainty is increased in tests that are retaken and in persons with educational disadvantages. As in risk assessment, this is not surprising, because the test attempts to quantify an essentially nonnumeric quality, the likelihood of success as a law student.

Most important, a purely numerical test misses the whole person. Struggles against adversity, work experience in positions of responsibility, volunteerism and civic-mindedness, risk-taking in course selection, strong written recommendations, and a persuasive personal statement are all positive indicators of success in law school and the legal profession, yet they resist any quantitative measure, and they certainly escape the LSAT. A purely quantitative formula also ignores important admissions goals other than attracting students with high academic

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126. Reference Manual, supra note 121, at 3.4-3.5.
127. See Ted Sizer, What's Wrong with Standardized Tests, N.Y. TIMES, Jan. 8, 1995, 4A, at 58 (arguing that standardized tests cannot predict long-term educational success and that, as a result, other factors must be considered).
128. Reference Manual, supra note 121, at 3.5. LSAS states that the LSAT score is "no more than an approximate measure." Id. When comparing test takers, "[t] is likely that small differences in scores are due to measurement error rather than to meaningful differences in ability." Id.
129. Id. at 3.6-3.8.
130. See Simien, supra note 125, at 380-86 ("Should [law schools] be selecting law students on the basis of academic ability or ... other more important factors?"); Steve DeMitro, Putting the LSAT to the Test, Chi. Daily L. Bull., Dec. 27, 1991, at 2 (arguing that the LSAT inaccurately filters out applicants to law schools).
ability as measured by testing. In a law school, these goals include enrolling a class that is diverse in (among other things) ethnicity, gender, age, religion, geographic background, undergraduate background, and professional aspirations. Many, myself included, believe that a diverse class enriches students' legal training by exposing them to different ideas, perspectives, and points of view. Relying solely on the LSAT would not necessarily promote, and could well frustrate, these goals. Similarly, when setting environmental standards and priorities, one needs to account for distributional effects, moral culpability, and equity, as well as risk. Both risk assessment and the LSAT, therefore, are useful only in connection with other considerations. More broadly, the LSAT analogy serves as a reminder that environmental concerns, like many things in life, cannot be reduced to a unidimensional inquiry.

Finally, it is important to let the affected party be heard in his or her own voice, and it is common for college and law school application processes to encourage submission of writing samples and personal statements. At one level, this merely recognizes the principle of procedural fairness that everyone has a "right to be heard." At another level, personal presentation can help to correct inaccuracies in testing or grades and can add important information. (In the risk context, we have seen that lay people do not necessarily conceive of risk in numerical, quantitative terms.) Most importantly, a person's own voice is essential to understanding the whole person and the whole situation, instead of just one facet.

Perhaps the most striking similarity between risk assessment and standardized testing is that both their most ardent proponents and their...
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critics attribute enormously more power and influence to them than do their sponsors. Proponents tout risk assessment as a scientific, objective way to make regulatory decisions that will quell the influences of irrational public pressure and ridiculously conservative assumptions and estimates. Likewise, standardized tests have been represented as infallible and precise measures of human intellect. Critics declare both to be either worthless or irrelevant, or both, to the matter at hand.

The real concern, however, is not slavish devotion to risk assessments or to tests, but the more subtle problem that they will have undue influence in making decisions. Numbers are seductive: they imply a degree of accuracy and certainty that is often unjustified. Past overselling of accuracy and certainty may have contributed to this misperception, despite current disclaimers. Moreover, numerical descriptors tend to swamp "soft" variables of the kinds described above. It is not appropriate, in other words, to mandate a particular formula or a single criterion for making the evaluation and ranking decisions for which risk assessment and the LSAT are used. Numerical measures have important uses, among them providing a starting place for analysis. They supply some bearings and some context, and they may indicate outliers—risks that are clearly emergencies or clearly trivial. For the great majority of cases to which the risk assessment bills apply, however, judgment should be based on a broader look at all


citations:

135. See 141 Cong. Rec. S52,034-01 (daily ed. Feb. 2, 1995) (statement of Senator Murkowski) ("So often ... decisions are made on the basis of emotion ... instead of ... being made on sound science. ... Congress needs to require agencies to use sound science, risk assessment, and cost-benefit analysis in the regulatory decisionmaking process."). But see Regulatory Impact Analysis Project, Inc., supra note 1, at 240-47 (concluding that policy decisions are unavoidable in risk assessment and recommending that they should be explicitly addressed); John D. Graham, Do We Know Enough to Take a Risk-Based Approach?, EPA J., Mar.-Apr. 1991, at 36, 36 (stating that "some citizens may be deluded into thinking that comparative risk analysis is a purely scientific undertaking").

136. Examples of overselling and the reaction can be found in Crouse & Trusheim, supra note 125, at 16-39; Owen, supra note 125, at 33-76.

137. See Crouse & Trusheim, supra note 125, at 16-39; see also Goldstein, supra note 44, at 37 (suggesting that one reason for the preoccupation with risk assessment is that it has been oversold); McCloskey Speech, supra note 63, at 3 ("Because of its judgmental nature, [risk assessment] should not be turned into a technocratic exercise that reflects a false sense of precision and scientific certainty."); Should We Set Priorities Based on Risk Analysis?, supra note 71, at 21 (section by Lawrie Mott).

138. See California Comparative Risk Project, supra note 63, at 15 ("Focusing on the quantitative aspects of risk does not provide enough information on the qualitative aspects . . . ."); Simien, supra note 125, at 378 (contending that the LSAT overemphasizes academic accomplishment); McCarthy, supra note 131, at A19 ("[LSATs] reveal nothing about the applicant's ideals, ethics, or moral values . . . .").

139. LSAS cautions against the use of scores, even to determine whether applicants are clearly admissible, without further empirical verification. Reference Manual, supra note 121, at A.1.
of the relevant considerations.

IV. Conclusion: Hidden Agendas

The likelihood that some of the provisions of the risk assessment bills will impede environmental protection is not news to many of the sponsors of risk assessment regulation.\textsuperscript{140} They regard such consequences as a desirable side-effect. The view that environmental regulation is generally too stringent and rigid is a defensible one. But the use of facially neutral risk assessment legislation as the means to effect that result is obnoxious. If Congress is of the view that the underlying legislative standards are too stringent, then Congress should change them, explicitly and after public debate, not through obscure technical passages in what is ostensibly a procedural reform bill.\textsuperscript{141} Risk assessors are frequently attacked for incorporating political values sub silentio in their risk assessments through the use of highly conservative assumptions;\textsuperscript{142} using procedural regulation to effect substantive change is no better.

The hazardous air pollutants provision of the Clean Air Act Amendments of 1990\textsuperscript{143} demonstrates that Congress is entirely capable of coming to grips, in an explicit and principled way, with the kinds of concerns that risk assessment legislation is intended to correct. Due to the law of diminishing returns, it may not be cost-effective to remedy the “last ten percent” of environmental risk. The last increments of environmental protection come at a huge cost relative to the first, so spending resources on the larger initial reductions is often more cost-effective.\textsuperscript{144} The underlying legislation, however, makes the choice to

\textsuperscript{140} Neither Senator J. Bennett Johnston nor Senator Daniel Patrick Moynihan favors a general retreat from environmental regulation, although both have sponsored risk assessment regulation and no doubt believe that the existing regulation could be improved.

\textsuperscript{141} This is precisely what House Bill 1022 § 202(a)-(b) and Senate Bill 343 § 2(a) (adding 5 U.S.C. § 623) do. \textit{Cf.} NAPA, supra note 36, at 29 (“Because setting priorities will require balancing different objectives, it is a policy exercise in which Congress must participate.”).

\textsuperscript{142} See Regulatory Impact Analysis Project, Inc., supra note 1, at 242 (finding that science policy decisions, mostly conservative ones, are rarely fully and fairly disclosed to the public); Goldstein, supra note 44, at 38 (stating that “it is bad public policy to allow the manager the seeming opportunity to amend the laws of nature”).


\textsuperscript{144} Breyer, supra note 60, at 11-19; \textit{see also} W. Kip Viscusi, \textit{Fatal Tradeoffs: Public and Private Responsibilities for Risk} 248-51 (1992); Noah, supra note 77, at 358; Steven M. Blush & Thomas H. Heitman, \textit{Train Wreck Along the River of Money: An Evaluation of the Hanford Cleanup} 1-47 to 1-48 (1995) (giving examples of the costs of achieving various cleanup levels). \textit{But see} Finkel, supra note 75, at 6.
go after the last ten percent. The original section 112 of the Clean Air Act required hazardous air pollutants to be stringently controlled, but within a “margin of safety” determined by the Administrator of the EPA.\textsuperscript{145} The program became the poster child for overregulation’s causing underregulation: in nearly twenty years, only a handful of chemicals were regulated.\textsuperscript{146} Congress abandoned that approach in the 1990 amendments and instead adopted a two-step process, the first step of which was to impose technology-based restrictions within a few years that would reduce emissions approximately ninety percent; the residual risk, the last ten percent, is to be addressed later.\textsuperscript{147}

It is interesting to note that the 1990 amendments also implicitly set regulatory priorities for hazardous air pollutants. Priorities can be seen as a three-dimensional problem: the decision-maker must choose between depth (the stringency) of regulation, breadth (the number of topics regulated), and length (the amount of time required to accomplish goals).\textsuperscript{148} In essence, the amendments chose breadth over depth and permitted additional time to reach the ultimate risk-based goal. It would be premature to hold up the 1990 amendments as a model of efficiency and effectiveness. Nevertheless, they are a model of Congress’ clearly identifying its goals and taking positions on the resource choices before it. The risk assessment bills can help Congress and agencies to make these judgments and to identify existing legislation that should be changed, but Congress should not go further and make those decisions through procedural elaboration.

Risk legislation has merit. Environmental regulation would benefit from a consistent approach to characterizing and communicating risk and from a coherent and rational approach to setting priorities. These features of the proposed legislation would also facilitate public participation in environmental decision-making, if such participation were provided in the bills. Other aspects of the proposed risk legislation, however, would paralyze environmental regulation with expensive, time-consuming, and unnecessary analysis. This is bad policy in itself.


\textsuperscript{148} A similar calculus applies to Superfund remediation. Given limited resources, one can choose to attack different problems in depth, resulting in fewer being addressed or a longer clean-up; or one can address several problems at once, recognizing that the clean-up will be less thorough, at least in the short run.
and a grossly inappropriate way to legislate a broad retreat from current legal standards. Even taken at face value, such legislation cannot cure uncertainty; nor can it transform all environmental issues and choices into risk decisions. Risk is not a sufficient end in itself, but flexible, inclusive risk legislation would make a good beginning.
APPENDIX

RISK ASSESSMENT, MANAGEMENT, AND
COMMUNICATION
AND PRIORITY SETTING

A. General Principles

1. These principles are intended to be goals for agency activities with respect to the assessment, management, and communication of environmental, health, and safety risks. Departmental programs should recognize that risk analysis is a tool—one of many, but nonetheless an important tool—in the regulatory tool kit. These principles are intended to provide a general policy framework for evaluating and reducing risks, while recognizing that risk analysis is an evolving process, and agencies must retain sufficient flexibility to incorporate scientific advances.

2. The principles in this document are intended to be applied and interpreted in the context of statutory policies and requirements, and Administration priorities.

3. As stated in Executive Order No. 12866, “In setting regulatory priorities, each agency shall consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdiction” [Section 1(b)(4)]. Further, in developing regulations, federal agencies should consider “... how the action will reduce risks to public health, safety, or the environment, as well as how the magnitude of the risk addressed by the action relates to other risks within the jurisdiction of the agency” [Section 4(c)(1)(D)].

4. In undertaking risk analyses, programs should establish and maintain a clear distinction between the identification, quantification, and characterization of risks, and the selection of methods or mechanisms for managing risks. Such a distinction, however, does not mean separation. Risk management decisions may induce changes in human behaviors that can alter risks (i.e., reduce, increase, or change their character), and these linkages must be incorporated into evaluations of the effectiveness of such decisions.

5. The depth or extent of the analysis of the risks, benefits, and costs associated with a decision should be commensurate with the nature and significance of the decision.

B. Principles of Risk Assessment

1. Departmental programs should employ the best reasonable obtainable information from the natural, physical, and social sciences to assess risks to health, safety, and the environment.
2. Characterizations of risks and of changes in the nature or magnitude of risks should be both qualitative and quantitative—that is, both descriptive and mathematical—consistent with available data. The characterizations should be broad enough to inform the range of activities to reduce risks.

3. Judgements [sic] used in developing a risk assessment, such as assumptions, defaults, and uncertainties, should be stated explicitly. The rationale for these judgements [sic] and their influence on the risk assessments should be articulated.

4. Risk assessments should encompass all appropriate hazards to human health and the environment (such as acute and chronic risks, including cancer and non-cancer risks). In addition to considering the full population at risk, attention should be directed to subpopulations (including future generations) that may be particularly susceptible to such risks and/or may be more highly exposed.

5. Peer-review of risk assessments can ensure that the highest professional standards are maintained. Therefore, programs should develop procedures to maximize its use.

6. Departmental programs should strive to adopt consistent approaches to evaluating the risks posed by hazardous agents or events.

C. Principles for Risk Management

1. In making risk management decisions with significant impact, programs should analyze the distribution of the risks and the benefits and costs (both direct and indirect, both quantifiable and non-quantifiable) associated with the selection or implementation of risk management strategies. Reasonably feasible risk management strategies including regulation, positive and negative economic incentives, and other ways to encourage behavioral changes to reduce risks (e.g., information dissemination), should be evaluated. Programs should employ the best available scientific, economic, and policy analysis, and such analyses should include explanations of significant assumptions, uncertainties, and the methods of data development.

2. Where programs have discretion to choose among alternative approaches to reducing risk, they should do so in the context of prevention programs and account for a broad range of relevant social and economic considerations such as equity, quality of life, individual preferences, and the magnitude and distribution of benefits and costs (both direct and indirect, both quantifiable and non-quantifiable).

3. Departmental programs should develop criteria and methods to
evaluate the effectiveness of risk management decisions.

D. Principles for Risk Communication

1. Risk communication should involve the open, two-way exchange of information between professionals, including both policy makers and “experts” in relevant disciplines, and the public.

2. Risk management goals should be stated clearly, and risk assessments and risk management decisions should be communicated accurately and objectively in a meaningful manner. To maximize public understanding and participation in risk management, programs should:
   a. explain the basis for significant assumptions, data, models, and inferences used or relied upon in the assessment or decision;
   b. describe the sources, extent, and magnitude of significant uncertainties associated with the assessment or decision;
   c. make appropriate risk comparisons, taking into account, for example, public attitudes with respect to voluntary versus involuntary risks; and
   d. provide timely, public access to relevant supporting documents, a reasonable opportunity for public comments, and a mechanism to incorporate public comments.

E. Principles for Priority Setting Using Risk Analysis

1. To inform priority setting, Departmental programs should seek to compare risks, grouping them, as appropriate, into broad categories of concern (e.g., high, moderate, and low) identifying the populations potentially at risk, and in context of uncertainty.

2. Programs should set priorities in managing risks. To set priorities, programs should take into account relevant management and social considerations such as different types of health or environmental impacts; individual preferences; the feasibility of reducing or avoiding risks; quality of life; environmental justice; and the magnitude and distribution of both short- and long-term benefits and costs.

3. The setting of priorities should be informed by internal agency experts and a broad range of individuals in state and local government, industry, academia, and nongovernmental organizations, as well as the public at large. Where possible, consensus views should be reflected in the setting of priorities.

4. Departmental programs should attempt to coordinate risk reduction efforts wherever feasible and appropriate.