

Not by Risk Alone: Reforming EPA Research Priorities

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Budget priorities for health and the environment have traditionally been negotiated and debated in a variety of political and policy terms. In recent years, however, some decisionmakers have proposed a single, uniform policy language, “risk based budgeting,” to allocate fiscal resources according to quantitative analyses of comparative risks to health and the environment. The ranking of risks according to their relative severity—that is, putting the “worst first”¹—is an attempt to translate traditional dialogues about budgetary legislation into the language of science.

Risk based budgeting proposals have particularly addressed—and been addressed by—the field of environmental research. In November, 1990, the Science Advisory Board (SAB) of the Environmental Protection Agency (EPA) published a study that compared the severities of various health and environmental risks.² Shortly after, President Bush announced a new commitment to use risk based budgeting for health and safety regulation.³ Recent legislative bills, including the proposed Ritter-Zimmer Amendment to the Environmental Research, Development, and Demonstration Authorization Act of 1991,⁴ have included specific provisions to initiate risk based budgeting for environmental research. Such proposals can be expected to reappear in the upcoming 103d Congress. Meanwhile, academic debates on the broader application of comparative risk analysis have intensified.⁵

1. This phrase originates from several sources. *E.g.*, *Fiscal Year 1992 EPA Research and Development Budget: Hearing Before the Subcomm. on Environment, U.S. House of Representatives*, 102d Cong., 1st Sess. 21 (1991) [hereinafter *EPA R&D FY 92 Hearing*] (statement of Don Ritter) (proposing research budgeting for “worst environmental risk first”); John S. Applegate, *Worst Things First: Risk, Information, and Regulatory Structure in Toxic Substances Control*, 9 *YALE J. ON REG.* 277 (1992); Peter H. Schuck, *The Worst Should Go First, Deferral Registries in Asbestos Litigation*, 15 *HARV. J.L. & PUB. POL’Y* 541 (1992).

2. SCIENCE ADVISORY BOARD, U.S. ENVIRONMENTAL PROTECTION AGENCY, EPA-SAB-EC-90-021, *REDUCING RISK: SETTING PRIORITIES AND STRATEGIES FOR ENVIRONMENTAL PROTECTION* 20 (1990) [hereinafter *REDUCING RISK*]. *See generally* Leslie Roberts, *Counting on Science at EPA*, 249 *SCIENCE* 616 (1990) (reporting EPA proposals for reforming priorities on basis of comparative risk).

3. 137 *CONG. REC.* H842 (daily ed. Feb. 4, 1991) (1992 budget message of President Bush) (making commitment “to employ risk management budgeting in addressing threats to health and safety”).

4. Environmental Research, Development, and Demonstration Authorization Act of 1991, H.R. 2404, 102d Cong., 1st Sess. § 14 (1991).

5. *See, e.g.*, Applegate, *supra* note 1; Robert F. Blomquist, *The EPA Science Advisory Board’s Report on “Reducing Risk”: Some Overarching Observations Regarding the Public Interest*, 22 *ENVTL. L.* 149 (1992);

Any effective prioritization ranks competing objectives by comparing their values to the decisionmaker and her constituency. Prioritization should be, almost by definition, systematic (to ensure that methods of evaluation are sufficiently similar to justify comparison) and comprehensive (to ensure that all objectives are compared). Accordingly, priorities should be explicitly and consciously set according to germane criteria. By this definition, prioritization is valuable as a form of reasoned planning.

Although scientific methods such as comparative risk analysis can contribute a reasoned and valuable focus to priority setting debates, the contributions that specialists make to the process of prioritization need not—and cannot—justify the allocation of resources according to some scientifically and infallibly persuasive set of facts. Any prioritization should—and will—embody fundamental values in comparing the relative values and requirements of relevant objectives.⁶ Indeed, as will be argued, the more values and criteria that are incorporated in the comparison, the more comprehensive the planning system and the better reasoned its selected criteria are likely to be.

This Note examines institutional and policy implications of risk based budgeting with a specific focus on EPA research. Part I outlines problems in the current priority setting budgetary processes of EPA's Office of Research and Development (ORD). Part II introduces current proposals for risk based budgeting and their advantages. Part III discusses two potential problems with these proposals: relative dominance of the process by the Executive; and the foreclosure of various other policies, including the accommodation of scientific uncertainty, the equalization of risk distribution, the comparison of alternative risk reduction methods and allocations of responsibility and resources, and the minimization of costs involved in changing agendas. To mitigate some of the problems introduced in Part III, Part IV recommends that Executive priority setting be largely moved out of the Office of Management and Budget and delegated to EPA, ORD, and the SAB. In addition, there should be a parallel delegation in Congress, with power shifting away from the appropriations committees to the environmental science subcommittees and Congress' Office of Technology Assessment (OTA). These delegations should enable risk based budgeting reform legislation to address other significant scientific, political, and bureaucratic policy considerations.⁷

Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 562, 610-16 (1992); *Integrated Pollution Control: A Symposium*, 22 ENVTL. L. 1 (1992). See generally Symposium, *Risk Assessment in Environmental Law*, 14 COLUM. J. ENVTL. L. 289 (1989). Resources for The Future, a Washington D.C. organization, plans a conference on comparative risk analysis in November 1992.

6. This Note is less concerned with ORD's environmental research priorities themselves than with how and by whom priorities should be set and the role of science in determining them. See generally SHEILA JASANOFF, *THE FIFTH BRANCH: SCIENCE ADVISERS AS POLICYMAKERS* (1990) (evaluating role of science advisers in determining policy).

7. Cf. BRUCE ACKERMAN, *RECONSTRUCTING AMERICAN LAW* 65-70 (1983) (arguing need for lawyers to learn to speak the language of statistical science critically).

I. CURRENT PRIORITY SETTING PROBLEMS IN EPA'S RESEARCH BUDGET

EPA research priority setting currently articulates no systematic or comprehensive, let alone scientific, quantitative policy.⁸ Instead, research priorities are determined substantially by fragmented statutes and piecemeal line items. Research legislation often has an applied, regulatory orientation and is subject to the potential abuse of political discretion.

A. Priority Setting Within the Budget Process

Although Congress and the Executive could prioritize rigorously during their centralized budgetary decisionmaking, the proportions of the environmental research budget are not set in an independent priority setting process, but rather are set almost *de facto*, in the course of the complex budget process of those branches. Budgeting power is shared by the Executive and Congress, where it is concentrated in the Office of Management and Budget (OMB) and the Appropriations Committees respectively. Judicial review of budgetary priorities is generally absent, whether this judicial deference is justified by indirect formulaic doctrines⁹ or by explicit policy considerations.¹⁰ Except in blatant cases of abuse, judicial deference leaves discretion over budget priorities to the other two branches of government.

In the Executive, environmental research priorities for EPA's ORD are initially formed during the long budgetary process in which ORD proposals,

8. Telephone Interviews with Samuel Rondberg, Designated Federal Official, Human Health Subcommittee, Science Advisory Board (Mar. 12 & Apr. 10, 1991) [hereinafter Rondberg Interview] (describing chain of practical priority setting by scientists, administrators, and congressmen with ever shallower experience and broader authority). EPA's ORD budget is divided in two ways by twelve diverse media areas (air, water, hazardous waste, etc.) and a motley set of twelve discipline areas or "program elements" (assessment, engineering, Great Lakes, etc.).

9. A series of D.C. Circuit opinions on agricultural research priorities exemplifies judicial deference to the other two branches on a variety of doctrinal grounds, although analysis reveals that interpretive and factual assumptions determine decisions far more than does the choice of doctrinal approach. *See, e.g.*, *Foundation on Economic Trends v. Lyng*, 943 F.2d 79, 85-86 (D.C. Cir. 1991) (Randolph, J.) (holding challenged agricultural germplasm research program was insufficiently specific to constitute "major" or "final federal action"); *id.* at 89-90 (Buckley, J., dissenting in part and concurring in part) (reaching similar conclusion on the merits); *Foundation on Economic Trends v. Block*, No. 84-3045, 1986 U.S. Dist. LEXIS at *12 (D.D.C. Apr. 29, 1986) (finding no "meaningful standards" to review priorities in agricultural research statute, leaving them in Department's "absolute discretion"), *aff'd sub nom.* *Foundation on Economic Trends v. Lyng*, 817 F.2d 882, 885 (D.C. Cir. 1987) (holding that research projects were too "diverse . . . discrete and independent" to constitute the "major Federal action" requiring environmental impact statement).

10. In deferring to executive priority setting in the context of agency enforcement, the Supreme Court has offered constitutional and institutional policy rationales. *See, e.g.*, *Heckler v. Chaney*, 470 U.S. 821, 838 (1985) (establishing presumption that a failure to enforce is "committed to agency discretion" and hence nonreviewable, with presumption rebuttable by contrary statutory indication or colorable constitutional rights violation).

In the area of environmental budgeting, the D.C. Circuit explicitly accorded interbranch comity in *National Wildlife Federation v. United States*, 626 F.2d 917, 924 n.10 (D.C. Cir. 1980) (withholding mandamus and declaratory relief for President's failure to justify budgetary requests falling short of levels in the administration's own, congressionally-approved Statement of Policy, "in order to show the utmost respect to the office of the Presidency").

modified by EPA superiors, are forwarded to the executive Office of Management and Budget. Under the authority of certain Executive Orders, OMB exercises potentially valuable oversight and discretion through which the President attempts to control a multitude of political, economic, and bureaucratic policies.¹¹ In Congress, the House and Senate subcommittees on the environment consider the President's budget priorities for EPA research,¹² but, although these congressional subcommittees focus, evaluate, and publicize priorities, they reportedly have little power over the final research and development budget because they do not hold the actual purse strings. The appropriations committees—informed by their subcommittees on Veterans Administration, Housing and Urban Development, and Independent Agencies—dominate the congressional budgetary process.¹³ Appropriations legislation is subject only to emergency deficit control legislation.¹⁴

B. Current Problems

1. Fragmentary Legislation and Line Items

The fragmentary, piecemeal structure of ORD's budgetary legislation impedes systematic, comprehensive priority setting. ORD is not funded by

11. *E.g.*, Exec. Order No. 12,498, 3 C.F.R. at 323 (1986), *reprinted in* 5 U.S.C. § 601 (1988) (strengthening centralized regulatory review by OMB and executive heads); Exec. Order No. 12,291, 3 C.F.R. at 127 (1982), *reprinted in* 5 U.S.C. § 601 (1988) (establishing OMB management of regulatory impact analysis, executive policy roles, and cost-benefit analysis; authorizing Council on Competitiveness to oversee executive policy and management, including consideration of economic effects of regulation by OMB and EPA). *See generally* JERRY L. MASHAW ET AL., *ADMINISTRATIVE LAW: THE AMERICAN PUBLIC LAW SYSTEM* 241-57 (3d ed. 1992) (discussing OMB role and reviewing assessments of its constitutional authority and performance); Jeffrey H. Howard and Linda E. Benfield, *Rulemaking in the Shadows: The Rise of OMB and Cost-Benefit Analysis in Environmental Decisionmaking*, 16 COLUM. J. ENVTL. L. 143 (1991).

12. Administrators or assistant administrators of ORD and chairs of the Science Advisory Board Research and Development Subcommittee are among the witnesses who report before Congress in the spring. The hearings for budget authorization begin before the House, specifically, the Subcommittee on Environment (formerly, Natural Resources, Agriculture Research, and Environment), after which an authorization bill is drafted and "marked up." The bill then proceeds to the Senate Committee on Environment and Public Works.

13. Rondberg Interview, *supra* note 8.

14. *E.g.*, The Emergency Deficit Control Act of 1985 (The "Gramm-Rudman-Hollings" Act) and its progeny, 2 U.S.C. §§ 900-09 (West Supp. 1992). Accordingly, final reconciliatory negotiations and the threat of sequestration remain to haunt the funds. OMB must then actually apportion the funds, and last minute alterations do occasionally occur. The Administrator retains discretion to shift or "reprogram" a small percentage of the budget, but must inform Congress of shifts above this percentage. Telephone Interviews with Jay Messer, Science Advisor to Senator Daniel P. Moynihan (Mar. 12 & Apr. 8, 1991) [hereinafter Messer Interviews]; Rondberg Interview, *supra* note 8. Funds are finally "obligated" and "outayed" to researchers in the academy, industry, and public interest groups who apply for grants; contracts for extramural research form approximately 50% of the ORD's budget. *See* SCIENCE ADVISORY BOARD, U.S. ENVIRONMENTAL PROTECTION AGENCY, EPA-SAB-EC-90-012, *REVIEW OF THE FISCAL 1991 PRESIDENT'S BUDGET FOR RESEARCH AND DEVELOPMENT* 3-4 and figure 1 (1990), *reprinted in* EPA R&D Fiscal Year 1991 Budget Request: *Hearing Before the Subcommittee on Natural Resources, Agriculture Research and Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives*, 101st Cong., 2d Sess. 45-56 (1990) [hereinafter *EPA R&D FY 91 Hearing*] (illustrating ratio between intramural salaries and expenses, and extramural research and development programs).

independent legislation, but by specialized sections of separate environmental acts.¹⁵ Moreover, agency officials have reportedly been dismayed by the dramatic increase in individual line items during recent years,¹⁶ which tend to accumulate additively in the budget, preventing the simultaneous comparison of all competing programs.

2. Regulatory Bias and the Problem of Basic Research

Because it faces directives that are essentially concerned with controlling pollution, ORD typically must orient its research toward immediate regulatory interests.¹⁷ Yet regulatory requirements particularly compromise the need for "basic" (also called "core" or "fundamental") research. Increasing the ratio of basic research to applied research is an important goal of many scientists and science bureaucrats in the budgetary review process.¹⁸ Presently, however, applied research is heavily emphasized because regulators are authorized to engage ORD scientists in research support for regulatory programs.¹⁹ While regulators often favor "applied" (regulatory or strategic) research because it addresses specific, immediate regulatory problems, the more theoretical scientific interests that basic research pursues may offer important long-term benefits or warnings.

15. See, e.g., Clean Air Act, 42 U.S.C. § 7403 (1988); Clean Water Act, 33 U.S.C. § 1254 (1988); Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6981 (1988); Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund), 42 U.S.C. § 9660 (1988); Toxic Substances Control Act (TOSCA), 15 U.S.C. § 2609 (1988); Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. § 136r (1988).

16. Rondberg Interview, *supra* note 8; Telephone Interview with Tom Veirce, Program Analyst, ORD (May 14, 1991) [hereinafter Veirce Interview].

17. For example, one of four purposes of the Clean Air Act Amendments of 1977 was "to initiate and accelerate a national research and development program to achieve the prevention and control of air pollution." 42 U.S.C. § 7401(b)(2) (1988). The Act directs the EPA Administrator to achieve this by conducting and coordinating research into the "causes, effects (including health and welfare effects), extent, prevention, and control of air pollution." 42 U.S.C.A. § 7403(a)(1) (West Supp. 1984-1990). This active role is significantly modified, however, by the section's detailed requirements for cooperation with other public and private agencies. The Administrator must not only assist public and private agencies technically and financially, but must actually perform research "concerning any specific problem . . . in cooperation with any air pollution control agency . . . to recommend . . . a solution . . . if he is requested to do so by such agency." 42 U.S.C. § 7403(a)(3) (1988). This language lends statutory weight to the administrative weight with which regulators tend to lean on research staff for short term projects and definite outcomes.

18. Cuts in the past decade, *see infra* note 72, not only reduced the ratio of ORD's budget within EPA, but reduced the funds available after imperative regulatory research needs have been met. The importance and problems of basic research are further elaborated in JASANOFF, *supra* note 6, at 76-80, 237.

19. For example, the mandates for promoting training and dissemination of more basic environmental research, *see supra* note 17, are qualified by requirements to provide such training to "personnel of air pollution control agencies . . . without charge." 42 U.S.C. § 7403(a)(5), (b)(5) (1988). Such mandates to support applied research may dilute the discretion of the EPA Administrator should she wish to set a different balance in ORD. Thus ORD recently took credit for working "closely with the EPA Office of Air and Radiation on setting priorities for research and technical support," but noted that "[t]he pressing nature of many of the specific requirements of the new air law necessitates substantial near-term support at the expense of longer term research." *EPA R&D FY 92 Hearing, supra* note 1, at 13-14 (statement of Erich Bretthauer, Assistant Administrator, EPA Office of Research and Development).

3. *Loss of Critical Mass*

Without adequate planning, certain programs may fall below so-called critical mass. Without funds sufficient to produce results of any significance, such programs impose waste; they might as well not have been funded at all. For example, the 1991 request for pollution prevention, a program that aims to reduce disposal, cleaning, and recycling, arguably failed to reach critical mass. Ironically, the \$11.3 million request was less than the cost of cleaning just one of the many failed recycling plants on the Superfund list! As one science administrator remarked, although pollution prevention is "routinely" described as "top priority, . . . [y]ou can't get much research for \$11 million."²⁰ Generally, the failure to plan and provide for adequate funding is exacerbated by across-the-board cuts in the closing stages of the budgetary process. When all programs are indiscriminately cut by a fixed proportion, high priority areas will get less funds, but the lowest priorities may get too little.

4. *Special Interests*

Allegations of improperly motivated "special interests" plague the priority setting process. Interviews with government officials indicate the undocumented but pervasive influence of partisan and professional concerns and opportunism during both executive priority setting and congressional hearings, particularly where line items are concerned. OMB has also been accused of unwarranted interference with other Executive representations²¹ and responsibilities²² to Congress. Illustrating the mutual suspicions and preemptive strategies inherent

20. *EPA R&D FY 91 Hearing*, *supra* note 14, at 67 (statement of Joel Hirschhorn, Senior Associate and Project Director, Office of Technology Assessment).

21. Since 1985, EPA's Science Advisory Board (SAB) has critically reviewed the EPA research and development portion of the President's budget, with periodic expressions of frustration, including criticism of uncooperative action by OMB. *See, e.g.*, John Neuhold, *Cover Letter to ENVIRONMENTAL PROTECTION AGENCY, RESEARCH STRATEGIES ADVISORY COMMITTEE, EPA-SAB-RSAC-92-017, AN SAB REPORT: REVIEW OF FY 1993 PRESIDENT'S BUDGET REQUEST FOR R&D (1992)* (criticizing OMB for "last-minute delivery" of budgetary data for review and advocating use of errata sheets and improved and consistent categorization). SAB members were previously frustrated when their reviews of budget priorities were confined to five year plans. Letter from Raymond Loehr, Chairman, SAB and John Neuhold, Chairman, R&D Budget Review Subcommittee, to James H. Scheuer, Chairman, Subcommittee on Natural Resources, Agriculture Research, and Environment, *reprinted in EPA R&D FY 91 Hearing, supra* note 14, at 35. *See generally* SCIENCE ADVISORY BOARD, EPA, SCIENCE ADVISORY BOARD: TAKING STOCK/REACHING OUT, ANNUAL REPORT OF THE DIRECTOR FOR FISCAL YEAR 1989 (1990).

22. For example, impropriety has been suggested in OMB's commissioning of its own scientific investigations at a crucial stage in the Montreal negotiations on regulating ozone-depleting substances, allegedly attempting to undermine the strong interagency consensus and international negotiating position which the State Department and U.S. Ambassador had achieved under their congressional mandate. RICHARD E. BENEDICK, *OZONE DIPLOMACY: NEW DIRECTIONS IN SAFEGUARDING THE PLANET* 59-62 (1991). President Reagan ultimately sided with Secretary of State Schultz and the Ambassador against the OMB position. *Id.* at 65-67. *Cf.* 42 U.S.C. § 7456 (1988) (repealed 1990) (directing President through Secretary of State and Assistant Secretary of State for Oceans, International and Scientific Affairs to negotiate international treaties etc. for ozone research and protection).

in testimony before Congress, one official confidentially quoted a previous EPA administrator as wryly advising that environmental risks should be measured as “risks to the Administrator!”

Of course, the characterization of particular portions of the budget as either narrowly biased or appropriately directed is itself highly controversial, especially when allegations fail to specify the legal or ethical norms allegedly violated, or the assumptions and biases of the critic. Decisionmakers may well describe their own projects as paying legitimate attention to particular problems, while casting aspersions on the motivations behind their opponents’ projects.²³ It remains difficult to imagine how any legislative project would not be open to such charges.²⁴ Nevertheless, the absence of common criteria for debating the merits of disparate programs and setting priorities certainly exacerbates rumors and possibly the opportunities for abuse, however defined.

II. RISK BASED BUDGETING PROPOSALS

Risk based budgeting is the leading, if somewhat limited, methodological candidate for reforming priorities in the fragmented, regulatory environmental budget.

A. Executive and Legislative Proposals

The SAB’s comparative study, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*,²⁵ summarized the findings of three SAB subcommittee studies.²⁶ Comparing ecological risks, the study analyzed

23. For example, at recent hearings of the House Subcommittee on Veterans Administration, Housing and Urban Development, and Independent Agencies, Congressman Bill Green (R-N.Y.) questioned the omission from the agency’s new budget request of a line item added by the Appropriations Committee the previous year. Don Clay, Acting Assistant Administrator for Air and Radiation, responded for the EPA that the quarter million dollars for air research and planning had unfairly favored Northeastern states. *Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for 1990: Hearings Before a Subcomm. of the Comm. on Appropriations, U.S. House of Representatives*, 101st Cong., 1st Sess. 64 (1989). See also, e.g., Colin Norman, *Science Budget: Growth Amid Red Ink*, 251 SCIENCE 616, 616-18 (outlining executive criticism of \$810 million in congressionally earmarked line items, but describing other special programs and cuts favored by the Executive).

24. See generally Peter H. Aranson et al., *A Theory of Legislative Delegation*, 68 CORNELL L. REV. 1, 32-33, 41-43 (1982) (summarizing strategic tendencies of legislative process; modelling incentives for President and other elected officials to provide private benefits).

Besides the controversial aspects of characterization, researchers face difficulties because portions of the budget are often aggregated or ambiguously reallocated, Telephone Interview with Oscar Morales, Program Analyst, Office of Research and Development (Apr. 10, 1991), and because ORD officials, otherwise helpful, may be reluctant to release budgetary documents, Veirce, ORD, *supra* note 14.

25. REDUCING RISK, *supra* note 2.

26. SCIENCE ADVISORY BOARD, ENVIRONMENTAL PROTECTION AGENCY, EPA-SAB-EC-90-021A, APPENDIX A: THE REPORT OF THE ECOLOGY AND WELFARE SUBCOMMITTEE (1990); EPA-SAB-EC-90-021B, APPENDIX B: THE REPORT OF THE HUMAN HEALTH SUBCOMMITTEE (1990); and EPA-SAB-EC-90-021C, APPENDIX C: THE REPORT OF THE STRATEGIC OPTIONS SUBCOMMITTEE (1990) [hereinafter REDUCING RISK, APPENDIX A, B, or C]. REDUCING RISK, *supra* note 2, was the work of the SAB’s Relative Risk Reduction Strategies Committee.

potential harms to humans and other species as well as their relative permanence and geographical scope.²⁷ To compare health risks, the study analyzed factors such as the number of people at risk and the probability and severity of health effects.²⁸ The Strategic Options Subcommittee detailed the risk based budgeting proposal in an appendix to the Report.²⁹ Criticizing EPA's current orientation and statutory structure as generally remedial and unintegrated,³⁰ SAB urged EPA to plan and budget on the basis of comparative risk research.³¹

Six months (and twenty thousand copies) after the publication of *Reducing Risk*,³² the House Committee on Science, Space, and Technology adopted the first legislative bill requiring EPA's research budget proposals to take account of scientific comparisons of risks. "Risk-based budgeting" formed a section of the proposed Ritter-Zimmer amendment to the Environmental Research, Development, and Demonstration Authorization Act of 1991.³³ This legislation would have required the Administrator of EPA to identify, assess, define, prioritize, coordinate, plan, budget, and report to Congress on priorities—"at least [ten] research issues, correlating to environmental hazards in the category of highest risk to human health and the environment"—including priorities in preventative "source reduction."³⁴ In the Senate, a broader bill for an Environmental Risk Reduction Act proposed not only comparative risk research, but also direct guidance for regulatory decisionmaking.³⁵ Senator Daniel P. Moynihan sponsored the legislation to establish SAB committees on relative environmental risks and benefits; to establish an interagency panel on risk assessment and

27. The Ecology and Welfare Subcommittee of SAB's Relative Risk Reduction Strategies Committee summarized "Relatively High Risks" as habitat alteration and destruction (including wetland degradation, erosion, and deforestation); species extinction and the overall loss of biological diversity; stratospheric ozone depletion; and global climate change. "Relatively Medium Risks" were herbicides and pesticides; toxics, nutrients, biochemical oxygen demand and turbidity in surface waters; acid deposition; and airborne toxics. "Relatively Low Risks" included oil spills; groundwater pollution; radionuclides; acid runoff to surface waters; and thermal pollution. *REDUCING RISK*, *supra* note 2, at 13.

28. The Human Health Subcommittee of SAB's Relative Risk Reduction Strategies Committee summarized "Risks to Human Health" as ambient air pollutants; worker exposure to chemicals in industry and agriculture; indoor pollution; drinking water pollutants. These were classified as "relatively high-risk rankings . . . supported more firmly by the available data than . . . other health problems." *REDUCING RISK*, *supra* note 2, at 14. This subcommittee report thus actually presented a ranking of scientific reliability, not a ranking of risks. For example, "pesticide residues on food and toxic chemicals in consumer products" received only a cursory mention. *Id.*

29. *REDUCING RISK APPENDIX C*, *supra* note 26, at 7-8, 59-60.

30. *REDUCING RISK*, *supra* note 2, at 3.

31. *REDUCING RISK*, *supra* note 2, at 6 (recommendations 1, 3, 4, and 5). Other recommendations urged EPA to make ecological considerations equal to health (recommendation 2) and economics (recommendation 10) in general public policy-making (recommendation 8), and to supplement regulation with market incentives (recommendation 6), pollution prevention (recommendation 7), and public education (recommendation 9).

32. Telephone Conversation with Joanna Foellmer, Staffmember, SAB (Apr. 3, 1991) (describing sales).

33. Environmental Research, Development, and Demonstration Authorization Act of 1991, H.R. 2404, 102d Cong., 1st Sess. § 14 (1991).

34. *Id.*

35. S. 2132, 102d Cong., 1st Sess. (1991); *cf.* H.R. 5435, 100th Cong., 2d Sess. (1988) (proposing Comprehensive Environmental Risk Management Act).

reduction; and to set EPA priorities according to the likelihood, seriousness, magnitude, and irreversibility of health, welfare, and ecological risks.³⁶

While ORD is seen as an appropriate bureau to begin testing the legislative policy of unifying the debate on risk,³⁷ congressional observers regard the broader application of risk based budgeting between regulatory programs as unrealistic at present.³⁸ Nevertheless, in a general climate conducive to large scale, if not systematic, prioritization³⁹ and science based legislation,⁴⁰ future risk based budgeting reform bills can be expected.

B. *The Promise of Risk Based Budgeting*

Risk based budgeting attempts to provide a scientific method for setting environmental priorities, including research priorities, by enriching the relevant debates with both a comprehensive system and well-articulated, specific criteria. Risk is "systematic" when it serves as a common criterion for comparing competing environmental objectives, and it is "comprehensive" when it is broadly applicable to any such objectives. Risk can be explicitly, even quantitatively, estimated and is surely a germane criterion for evaluating environmental problems.

Quantitative risk analysis is complex because it involves specialized experimentation, computation, and estimation. Risk based priority setting would be delegated to government scientists and specialized administrators who would be well-situated to quantify various aspects of risk and to evaluate competing

36. S. 2132, 102d Cong., 1st Sess. § 4(a) (1991).

37. See *EPA R&D FY 92 Hearing*, *supra* note 1, at 21 (statement of Don Ritter) (describing ORD as "cornerstone" of effort to address "worst environmental risk first").

38. Messer Interviews, *supra* note 14; cf. *The Role of Science at EPA and Budget Authorization for EPA's Office of Research and Development: Hearing Before the Committee on Science, Space, and Technology*, 102d Cong., 2d Sess. (1992) (testimony of Adam M. Finkel, Risk Management Fellow, Resources for the Future) (presenting opposing concerns about the sufficiency of environmental science, public acceptability, and systemic factors of lifestyle and innovation); William K. Stevens, *What Really Threatens the Environment?* N.Y. TIMES, Jan. 29, 1991, at C4 (late ed.) (reporting doubts about initiatives).

39. Traditional inertia in the budget may be lessening during the current congressional dissension over priorities. Budgetary debates have become more fierce as old concerns for annual incremental adjustments have given way to debates over budgetary bases and priorities. AARON B. WILDAVSKY, *THE NEW POLITICS OF THE BUDGETARY PROCESS* 29, 199-203 (1988). Traditional incremental budgeting takes account of the previous fiscal period as a "base." Two alternatives budget more comprehensively: (1) "zero-based budgeting," which is a total reconsideration of expenditures for discrete programs without reference to their previous bases; and (2) "planning, programming, and budgeting" across policy areas. *Id.* at 416-20.

40. Messer Interviews, *supra* note 14. See, e.g., Acid Precipitation Act of 1980, 42 U.S.C.A. § 8903-06 (West 1983 & Supp. 1991) (requiring National Acid Precipitation Assessment Program (NAPAP)); Federal Insecticide, Fungicide, and Rodenticide Act of 1972 (FIFRA), 7 U.S.C. § 136a-y (1988); Toxic Substances Control Act of 1976 (TOSCA), 15 U.S.C. §§ 2601-71 (1988) (mandating comparison of costs and benefits to measure acceptability of certain risks); U.S. Global Change Research Program (USGCRP), see *infra* notes 119-128 and accompanying text; the Environmental Monitoring and Assessment Program (EMAP), see 55 Fed. Reg. 12,725, 12,726 (1990). Another parallel is the assumption of a common metric in the provisions for trading air pollution licenses in the Clean Air Act Amendments of 1990, 42 U.S.C.A. § 7671(f) (West Supp. 1984-1990). E. Donald Elliott, General Counsel, EPA, and Professor, Yale Law School, Master's Talk at Saybrook College, Yale University (Apr. 12, 1991) [hereinafter Elliott Talk].

research initiatives and directions.⁴¹ Risk based budgeting can therefore be regarded, even by those skeptical of technocracy, as scientific in its practical operation, methodological sweep, and precision, but, of course, not as an ideal, infallible truth.

Some argue that quantitative prioritization is particularly necessary because resources are limited.⁴² While resources are always limited, extreme scarcity certainly exacerbates allocation problems; the \$279 million that EPA spent for research and development in 1992⁴³ buys less than the \$206 million it spent in 1981,⁴⁴ while ORD's research demands have doubled.⁴⁵ However, the argument is somewhat weakened by the corollary that when resources are especially scarce, the cost of quantitative prioritization may itself need to be limited.⁴⁶

III. PROBLEMS WITH CURRENT RISK BASED BUDGETING PROPOSALS

Despite the promise of risk based budgeting, decisionmakers should not allow it to dominate the budget process, thereby increasing Executive influence and displacing other important considerations of environmental research policy.

A. Increasing Executive Influence

Current proposals would delegate risk based budgeting decisions primarily to specialists within the executive branch, and thus would increase the relative

41. Advocates favor delegation due to the economic efficiency of discretion exercised by experts. Jerry L. Mashaw, *Prodelegation: Why Administrators Should Make Political Decisions*, 1 J. L. ECON. & ORG. 81, 91-93 (1985) [hereinafter Mashaw, *Prodelegation*] (favoring delegation when specialists' administrative savings in decisionmaking and implementation exceed the cost of agency noncompliance and errors, a likely scenario when noncompliance and errors can be institutionally deterred).

42. See, e.g., Applegate, *supra* note 1, at 318-27 (presenting arguments for risk based priority setting based on scarcity, accountability, and efficiencies in regulating and gathering information).

43. OFFICE OF MANAGEMENT AND BUDGET, EXECUTIVE OFFICE OF THE PRESIDENT, BUDGET OF THE UNITED STATES GOVERNMENT FISCAL YEAR 1993—APPENDIX ONE 867 (1992) [hereinafter U.S. BUDGET FY 93] (outlays excluding salaries and expenses).

44. OFFICE OF MANAGEMENT AND BUDGET, EXECUTIVE OFFICE OF THE PRESIDENT, BUDGET OF THE UNITED STATES GOVERNMENT FISCAL YEAR 1983—APPENDIX I-S2 (1982) (excluding salaries and expenses).

45. SCIENCE ADVISORY BOARD, U.S. ENVIRONMENTAL PROTECTION AGENCY, EPA-SAB-91-005, REPORT OF THE RESEARCH AND DEVELOPMENT BUDGET REVIEW COMMITTEE: REVIEW OF THE FISCAL YEAR 1992 PRESIDENT'S BUDGET FOR RESEARCH AND DEVELOPMENT ii, 3 (1991) [hereinafter SAB FY 92 REVIEW], reprinted in *EPA R&D FY 92 Hearing*, *supra* note 1, at 80, 85 (describing decline in purchasing power of ORD's budget and warning that ORD "will continue to be incapable of providing an adequate response to environmental issues without a significant infusion of resources"). Since 1988, SAB has recommended a doubling of the ORD budget within five years. SCIENCE ADVISORY BOARD, U.S. ENVIRONMENTAL PROTECTION AGENCY, SAB-EC-88-040, FUTURE RISK: RESEARCH STRATEGIES FOR THE 1990'S 5, 18 (1988). In general, the volume of research stemming from academic institutions as well as their demand for funds has doubled in the past two decades. Leon M. Lederman, *Science: The End of the Frontier?*, 251 SCIENCE supp. 8-10 (Jan. 1991) (documenting pessimism over funding of academic R&D in spite of 20% growth in funding over 20 years, due to increased costs and complexity of research, regulation, and overhead, and the doubling of university scientists during this period).

46. See *infra* text accompanying notes 77-86 (discussing potential bureaucratic problems of systematic prioritization).

influence of the Executive over the priority setting process. As proposed, comparative risk analyses would be performed within EPA itself and are unlikely to be reviewed in equal depth by courts or even Congress.⁴⁷

To some, of course, an increase in Executive authority in these matters might seem desirable. Those who share the policy orientation of the current presidency might wish to see its power augmented. Moreover, regardless of the personal or partisan composition of the Executive institutions concerned, it seems most efficient to delegate a task once, rather than twice; since Executive institutions have traditionally supported science policy functions, their experience and cultivated expertise make them the logical agents for delegation.

However, there are reasons to be cautious about concentrating such new authority in the Executive branch. Questions of institutional design should transcend partisan and presidential policy orientations. Moreover, bureaucratic efficiency, however important, should not be the sole criterion for evaluating the institutional and policy implications of risk based budgeting. The placement of risk based budgeting in the Executive alone would be a delegation of unprecedented scope, with significant effects on the presentation of budgetary proposals to Congress and, ultimately, the public.

Risk based budgeting legislation is more ambitious in scope than narrower proposals for making quantitative comparisons among qualitatively similar goals or risks.⁴⁸ Within a group of similar risks or an individual research discipline (pesticides or pesticide research, for instance), consensus is relatively easy to achieve. Across disciplinary boundaries, however, even methodological matters become extremely controversial.⁴⁹ Risk based budgeting would compare risks

47. See *supra* notes 33-35 and accompanying text (discussing proposed bills).

48. See, e.g., OFFICE OF TECHNOLOGY ASSESSMENT, OTA-SET-490, *FEDERALLY FUNDED RESEARCH: DECISIONS FOR A DECADE 17-18 & n.29* (1991) (distinguishing priorities 'across' and 'within' research fields); Applegate, *supra* note 1 at 350 (acknowledging that "[w]ithin a single program, choices are relatively easy" because costs, benefits, and risks of chemicals are similar).

On intradisciplinary prioritization, see, for example, Bruce N. Ames, *Dietary Carcinogens and Anticarcinogens*, 221 *SCIENCE* 1256, 1261 (1983) (recommending prioritization of dietary risks); Applegate, *supra* note 1 (proposing comparative risk analysis to restructure EPA regulation of toxic substances); John N. Bahcall, *Prioritizing Scientific Initiatives*, 251 *SCIENCE* 1412, 1412-13 (1991) (describing research prioritization in astronomy and astrophysics), citing NATIONAL RESEARCH COUNCIL, *THE DECADE OF DISCOVERY IN ASTRONOMY AND ASTROPHYSICS* (1991); Bruce A Bolt, *Balance of Risks and Benefits in Preparation for Earthquakes*, 251 *SCIENCE* 169, 172-73 (1991) (explaining prioritization of earthquake engineering studies and reconstruction); Leslie Roberts, *Ranking the Rainforests*, 251 *SCIENCE* 1559 (1991) (describing prioritization program for forest conservation); Schuck, *supra* note 1 (proposing prioritization of trials according to severity of asbestos-related conditions).

On similarly intradisciplinary comparative studies or "meta-analyses," which strive to synthesize the results of earlier applied or basic studies, compare Charles Mann, *Meta-Analysis in the Breech*, 249 *SCIENCE* 476 (1990) (describing meta-analysis); Henry S. Sacks et al., *Meta-analyses of Randomized Controlled Trials*, 316 *NEW ENG. J. MED.* 450 (1987) (statistically analyzing and evaluating meta-analyses themselves).

49. See, e.g., H.R. 4192, 98th Cong., 1st Sess. (1983) (unsuccessfully proposing coordination across agencies of basic methodology for risk-assessments). For the controversy, compare H.R. 4192, *The Risk Assessment Research and Demonstration Act of 1983: Hearings Before the Subcomm. on Natural Resources, Agriculture Research and Environment of the Comm. on Science and Technology, U.S. House of Representatives*, 98th Cong., 2d Sess. 20-23 (1984) (statement of Nicholas Ashford, director, Center for Policy Alternatives, MIT) (criticizing centralized risk assessment as uncertain, unnecessary, and potentially influential over

as diverse as ozone depletion and hazardous waste sites, with an attendant range of scientific, political, and bureaucratic conflicts, discussed in the following section.

Although executive agency scientists would not make final policy decisions, their work could form the basis for a new style of budgetary presentation by OMB to Congress. Since "scientific" comparisons of risk can provide a persuasive political rhetoric, Congress should be wary of legislation that empowers scientists in the area of budgetary prioritization and would thus lend to OMB policy presentations an aura of legitimacy not shared by Congressional proposals. In the absence of sufficient reason to shift the current balance of budgetary power (and, as will be argued, because risk analysis alone provides insufficient reason), Congress should at least preserve the existing balance of power over budgetary priorities.⁵⁰

The problem of increasing executive influence over Congress through impressive scientific presentations extends to the formation of public opinion. Budgetary reform ultimately depends on political reform.⁵¹ The U.S. public already considers environmental issues a top priority,⁵² but through polling, funding, and public service reports and announcements, the government plays an important role in shaping and taking account of the details of public opinion.⁵³ As people develop increasing concern about the environment and begin to make informed comparisons of risk, the federal government's responsibility as educator and surgeon. Risk based budgeting has the potential for adding the legitimacy of

Congress and public) with *id.* at 66-68 (statement of Peter W. Huber, engineer and law clerk, U.S. Supreme Court) (defending centralized risk assessment for systematic rationality and potential to "weaken, not strengthen, OMB's influence" and OMB's ability to "divide and conquer").

50. While the Constitution gives the President duties to inform and make recommendations, U.S. CONST. art. II, § 3, which surely includes priority setting recommendations, the Constitution explicitly grants Congress the powers to tax and spend, *id.*, art. I, § 8, cl.1.

51. WILDAVSKY, *supra* note 39, at 411.

52. Among national concerns, environmental concerns have intensified the most, holding major significance for 56% of those surveyed in 1987, and 78% in 1990. Luther P. Gerlach, *Global Thinking, Local Acting*, 15 EVALUATION REV. 120, 131 (1991) (referring to Roper Reports).

53. Detailed rankings of public opinion show that public assessments of individual environmental risks differ sharply from the rankings in the Executive's *Reducing Risk* study. See REDUCING RISK, APPENDIX C, *supra* note 26, at 129 (summarizing Roper Reports). Donald Hornstein opposes the argument that the public is vulnerable to cognitive errors and distortions of the relative magnitude of risks, based on variations of information availability, different evaluation of risks depending on whether they are characterized as losses or gains, and other prejudices (e.g., the "sexy crisis of the month," Messer Interviews, *supra* note 14). Hornstein gives several responses. First, scientists themselves are constrained by uncertainties, erroneous methods, and industry bias. Second, subordination of public interests to government risk analysis is likely to be viewed as illegitimately undemocratic, whatever the cognitive errors. Finally, Hornstein advances a rational basis for public evaluations—and alleged exaggerations—of risk: people perceive the speculative quality of technical assessment and fear particular aspects of catastrophes, such as extraordinary scales, unequal distributions, and uncontrollable agonies. Hornstein, *supra* note 5, at 610-16.

science to executive politics.⁵⁴ On balance the arguments in favor of a dual delegation are more persuasive.

B. *Displaced Policy Issues*

While risk based budgeting represents a significant attempt to translate scientific language into budgetary language, the translation is an act of policy⁵⁵ that allows a range of value choices and approaches: from circumspect restraint, to active prediction and exploration,⁵⁶ to distortion.

Focus on comparative risks may obscure a variety of other factors, such as scientific uncertainty, equality of risk distribution, costs of alternative risk reduction methods, allocation of responsibility and resources, and bureaucratic problems associated with changing agendas. Such factors should be incorporated in risk analyses used for budgetary purposes.

1. *Scientific Uncertainty*

“Scientific” priority setting is necessarily limited by scientific uncertainty. Research priority setting is particularly limited because research itself aims to reduce this very uncertainty. Planning the direction of research therefore remains a matter of policy that cannot be determined solely on the basis of quantitative analysis.

In environmental and epidemiological research, causation questions involve uncertainties that necessitate methodological assumptions and value judgments in statistical tasks.⁵⁷ Data may be excessive or lacking. (Latent diseases, for

54. Cf. WILLIAM K. REILLY, U.S. ENVIRONMENTAL PROTECTION AGENCY, 20Z-1011, AIMING BEFORE WE SHOOT: THE QUIET REVOLUTION IN ENVIRONMENTAL POLICY (1990) (prefacing announcement of SAB's *Reducing Risk* report by advertising executive environmental initiatives, mentioning president's name 23 times) (transcribing speech of Sept. 26, 1990 to National Press Club).

55. Even the internal methodologies of science are conditioned by social, commercial, and political functions and funding, see JASANOFF, *supra* note 6, at 12-14, and science can be expected to meet political resistance insofar as it threatens existing balances of power, see JOHN M. MENDELOFF, THE DILEMMA OF TOXIC SUBSTANCE REGULATION 137 (1988) (relating degree of industry opposition to strictness of regulatory standards), or lifestyle, see, e.g., Bruce N. Ames, *Dietary Carcinogens and Anticarcinogens*, 221 SCIENCE 1256, 1258-59 (1983) (citing epidemiological studies indicating that exposure to “natural” risks in lifestyle and diet, such as plant toxins and carcinogens, exceed those from man made toxic pesticides). Cf., e.g., *supra* note 22 (noting OMB use of research to allegedly jeopardize ozone negotiations).

56. In REDUCING RISK, *supra* note 2, at 13-14, for example, the circumspect Human Health Subcommittee shied away from the ordered approach of the Ecology and Welfare Subcommittee, and ranked health risks by degrees of evidentiary substantiation, not by severity of risk. See *supra* notes 27-28; Leslie Roberts, *Ranking the Risks Proves Contentious*, 249 SCIENCE 617 (1990) (describing different approaches of subcommittee chairmen). Cf. generally, JOSEPH S. FRUTON, CONTRASTS IN SCIENTIFIC STYLE: RESEARCH GROUPS IN THE CHEMICAL AND BIOCHEMICAL SCIENCES (1990).

57. See generally Austin Bradford Hill, *The Environment and Disease: Association or Causation?* in 58 PROC. ROYAL SOC'Y MED. 7-12 (1965) (outlining considerations supporting causal inferences); Frederick Mosteller, *Assessing Unknown Numbers: Order of Magnitude Estimation*, in STATISTICS AND PUBLIC POLICY (William B. Fairley and Frederick Mosteller eds., 1977); Richard Peto, *Distorting the Epidemiology of Cancer: The Need For a More Balanced Overview*, 284 NATURE 297 (1980).

example, involve possibly confounding or intervening factors; pollution involves substance movement, degradation, and reactivity.) Extrapolation entails methodological problems such as dose-response uncertainties and interspecies comparison; generalization is complicated by variabilities in human sensitivity.⁵⁸ Scientific paradigms can shift.⁵⁹ Risk assessment methodologies are also affected by the standards of risk management: the lower the standards of acceptable risk, the greater the tolerated margins for methodological error.

In addition, the probability of harm cannot be equated with the probability of achieving significant results in research. The significance of research is "often a serendipitous affair,"⁶⁰ unknown in advance. Historically, many of the greatest risks have arisen because of what was not known.⁶¹ One of the very purposes of environmental research is to determine which risks prevail and their respective magnitudes. Even when the probabilities of certain events are estimably small, their potential magnitude may justify research to reduce risk of error and other uncertainties in the premises and calculations of the estimated risk. The foremost example of such a risk is the possibly minuscule but potentially catastrophic danger of igniting the Earth's atmosphere or oceans by atomic explosions.⁶² Without considering the effect of uncertainty on experimental design and subsequent projections, comparisons of risks on the basis of current research cannot adequately determine future research policy.

2. *Inequality of Risk Distribution*

There are fundamental moral and philosophical problems with comparing the severity of different harms to different groups of people. Risks are often incommensurable, or comparable only by the suppression of crucial details or related issues. Furthermore, evaluation of risks begs the question of "risk for whom?" The same dangers pose different degrees of risk to different people, or numbers of people, and have diffuse or concentrated effects. Which people

58. Nicholas A. Ashford, *Risk Assessment and the Design of Policy for Worker Protection*, 3 AM. J. INDUS. MED. 241, 241-42 (1982); cf. Agency Procedures For Performing Regulatory Analysis of Rules, 1 C.F.R. § 305.85-2(7)(c) (1992) (recommending that agency rulemaking "must take into account . . . the limits of the methods and data used in the regulatory analysis").

59. See THOMAS KUHN, *THE STRUCTURE OF SCIENTIFIC REVOLUTIONS* 64-65, 90, 108-209 (1962) (explaining how revolutionary science alters the "paradigms" that determine areas and methods of research when existing paradigms are unable to account for accumulating theoretical and experimental anomalies). But see KARL POPPER, *QUANTUM THEORY AND THE SCHISM IN PHYSICS* 30-34 (1982) (considering evolution of "specific theories" adequate to account for progressive increase in scientific understanding).

60. Telephone Interview with Aubrey Stoch, Research Fellow, Yale Medical School (Apr. 4, 1991).

61. For example, chlorofluorocarbons were invented in the 1930's, used so extensively in refrigeration and aerosols that annual production reached 150,000 metric tons by 1960, and still exceeded 800,000 metric tons by the time their danger to stratospheric ozone was first suspected in 1974. BENEDICK, *supra* note 22, at 10-11 (1991).

62. The sparse scientific and historical literature, grave policy concerns, and mathematical aspects of this issue are discussed in Fred Commoner, *The Atmospheric Ignition Problem* (unpublished manuscript, on file with author).

should face which risks, and who should decide this issue, are questions of equity and federalism.

In analyzing the equality (or equity) of risk distribution, it is important to distinguish the aggregate risk (the total number of deaths or injuries) borne by a population from the average risk borne by an individual. It is also important to distinguish concentrated risks which threaten relatively predictable members of society from diffusely distributed risks which threaten relatively unpredictable groups. If aggregate risk were not a variable, the norm of distributional equality would simply mean that all members of society should bear a similar average risk, and that reducing the average risk of the majority slightly would not justify increasing the average risk of the minority substantially. In reality, however, aggregate risk *is* a variable: diffuse aggregate risks are often substantially higher than those concentrated on fewer, though more predictable, victims.⁶³ Thus, budgeting to equalize average risk directly conflicts with budgeting to minimize aggregate risk.

Many advocates of comparative risk policy strongly criticize the belief that average equity is preferable to a reduction in aggregate magnitude.⁶⁴ These critics focus on aggregate risk rather than on the average risk borne by members of particular populations and stress that diffusing risk *ex ante* does not reduce the gravity of actual harm *ex post*.⁶⁵ Their counterargument, heard from the Hill to Hartford, is that the Superfund program for cleaning hazardous waste sites should be made a lower priority because, in the aggregate, comparatively few people are at risk.⁶⁶

Nevertheless, like aggregate magnitude, equity surely should constitute an important, independent factor in the priority setting debate. The importance of equity is compounded by the foreseeability of risks, particularly concentrated risks; after all, risks are borne *before* actual harm occurs, at a time when they can be anticipated. A decision to abandon those who live dangerously near hazardous waste sites can be made more consciously than the decision to abandon more people to less predictable, diffuse risks. Recognizing the effect of prior knowledge on equity decisions, Guido Calabresi emphasizes how democratic societies take great pains to avoid making sacrificial decisions for

63. One example of a diffuse aggregate risk is that posed by ozone completion. *See, e.g.*, 137 CONG. REC. 15,097-98 (daily ed. Oct. 24, 1991) (statement of Sen. Baucus) (discussing one recent EPA estimate that due to ozone depletion, "12 million Americans would develop skin cancer, and more than 200,000 of them would die over the next 50 years").

64. Messer Interviews, *supra* note 14 (characterizing concern for equity as "equity fallacy"); *cf.* S. 2132, 102d Cong., 1st Sess. § 2(a)(4) (1991) (finding that "funds can only be used most effectively when they protect the largest number of people from the most egregious harm"). *But see* STATISTICS: A GUIDE TO THE UNKNOWN 84-85 (Judith M. Tanur et al. eds., 3d ed. 1989) (explaining "Simpson's Paradox" or "spurious correlations" in which comparisons of aggregated data are misleading when important categories of data are of different sizes).

65. *Cf.* Hornstein, *supra* note 5, at 595-98 (further distinguishing *ex ante* risk from *ex post* harm).

66. Warren Azano, Counsel, Aetna Insurance Company, Address as Visiting Speaker at Yale Law School (Apr. 18, 1991) (saying that "new scientific studies place hazardous wastes way down on the list of risks").

the good of the majority too deliberately.⁶⁷ Comparing facts and prioritizing problems, when these facts and problems are of different scales, involve judgments about equity. Statistical comparisons of aggregate risks can displace methodological and political knowledge of and attention to the average risk among smaller groups or individuals.⁶⁸

3. *Alternative Risk Reduction Methods and Allocations of Responsibilities and Resources*

Risk is not alone among issues deserving comparative analysis; decision-makers must also compare alternative methods of risk reduction (and their attendant costs) as well as different allocations of responsibilities and resources. The costs involved in responding to risks vary considerably depending upon the alternative reduction strategies selected. In fact, this variance often does not correlate to the magnitude of the risks reduced. For example, OMB claims that OSHA standards for underground construction sites save "38,000 lives for every one million people exposed to the risk, at a cost of \$100,000 per premature death averted," while it estimates that "EPA's proposed standards for municipal solid waste landfills would save less than one life for every million people exposed, at a cost [of] \$19.1 billion per death averted."⁶⁹ Risks should be compared, but so must the costs and impacts of alternative attempts at risk reduction.⁷⁰

Budgeting dominated by comparative risk analysis might also fail to make explicit choices about allocations of responsibility and resources. Regardless of relative risks, certain programs would be better executed by sharing and shifting responsibility and resources among other agencies. As currently proposed, risk based budgeting could all too easily proceed as if responsibility for research were to be allocated to EPA's ORD alone.⁷¹ However, environ-

67. GUIDO CALABRESI & PHILIP BOBBITT, *TRAGIC CHOICES* 76-78 (1978) (discussing society's manner of avoiding sacrificial choices by blaming a scapegoat or inducing "pure lambs" to volunteer); GUIDO CALABRESI, *IDEALS, BELIEFS, ATTITUDES, AND THE LAW* 1-7 (1985) (comparing and contrasting the automobile with hypothetical "evil deity" who negotiates societal boons in return for human sacrifices).

68. As noted *supra* note 56, the SAB's *Reducing Risk* subcommittees pursued different approaches. The Subcommittee on Ecology and Welfare ranked toxic substance risks to the global ecology lower than atmospheric and habitational disturbances. See *supra* text accompanying notes 27-28 (summarizing rankings). However, the Human Health Subcommittee placed similar toxic substances in their highest band of best documented risks. If *Reducing Risk*, *supra* note 2, is read without attention to the subcommittees' differing methods, and without consideration of questions of risk distribution, confusion of scales can arise. The problems of hazardous waste are not addressed simply by making so-called larger problems a higher priority.

69. *The Grim Math of Rating Risks*, 23 NAT'L J. 1280 (1991); see MENDELOFF, *supra* note 55, at 22-23 (tabulating another range of safety costs).

70. See Agency Procedures for Performing Regulatory Analysis of Rules, 1 C.F.R. § 305.85-2 (1992) (advising use of regulatory impact analyses in agency rulemaking); H.R. 2404, 102d Cong., 1st Sess., § 14(d)(4) (proposing legislation for EPA to "identify[] and describ[e] technological barriers, and opportunities for reducing or eliminating such barriers" to reduction of identified risks); Hornstein, *supra* note 5, at 616-29 (elaborating lack of consideration of alternatives in comparative risk analysis).

71. Cf. 1 C.F.R. § 305.85-2(7)(c) (1992) (recommending that agency rulemaking decisions "take into account the limits of the agency's statutory authority and its overall policy goals").

mental research priorities are, and should be, set not only among research grants and programs, but also among offices,⁷² agencies,⁷³ and general budgetary functions,⁷⁴ in interaction with economic regulation⁷⁵ and state or international decisionmakers.⁷⁶ Certain global risks should be shouldered in partnership with other agencies or international bodies; certain local risks should be addressed by states and municipalities. Lack of attention to the allocation of responsibility may easily distort the implications of comparative risk analysis for ORD.

The need to consider alternative allocation of resources is particularly pressing when program funds fall below a sufficient level of funding or critical mass. Risk based budgeting might well increase the resources allocated to high priorities but will not by itself ensure that low priorities receive critical mass. Funding that falls below this level would clearly be better allocated to alternative programs.

72. Of the EPA's \$5.9 billion dollar budget, U.S. BUDGET FY 93, *supra* note 43, at 96 (1992), ORD requests 8-9%, with \$491 million requested for FY 1992, SAB FY 92 REVIEW, *supra* note 45, at 3, reprinted in *EPA R&D FY 92 Hearing*, *supra* note 1, at 85. The program suffered devastating cuts in 1982-83, from which it has barely recovered in a decade, while research loads have doubled with increasing environmental risks and legislation. The cuts also forced a drastic decline in the ratio of ORD's budget to the total EPA budget. *Id.*

73. Interagency comparisons between environmental and health research departments in parallel agencies show that EPA's ORD forms less than a third of the federal research budget for environment and natural resources. NATIONAL SCIENCE FOUNDATION, NSF 90-311, FEDERAL R&D FUNDING BY BUDGET FUNCTION: FISCAL YEARS 1989-91, at 85 (1990) [hereinafter FEDERAL R&D].

74. R&D has formed approximately 5% of the federal budget since the mid-1970's, with approximately \$68 billion proposed for 1991. Between 1989 and 1991, funding for R&D concerning natural resources and the environment has formed approximately \$1.3 billion, or 2% of total federal R&D. Environmental research thus ranks sixth among the sixteen R&D budget functions in the National Science Foundation classification, which range widely from approximately \$41 billion proposed for defense R&D (61% of federal R&D) to a mere \$15 million dollars for general government research. As a ratio, research forms only 7.4 to 8% of the total environmental budget, ranking sixth again on the wide spectrum of NSF categories, in which research ranges from 0.1% of the general government budget and over 50% of the energy budget. *Id.* at 1-6. See generally AMERICAN ASS'N ADVANCEMENT SCI., AAAS REPORT 17: R&D IN FY 1993 (1992); AMERICAN ASS'N ADVANCEMENT SCI., CONGRESSIONAL ACTION ON R&D IN THE FISCAL YEAR 1992 BUDGET (1992) (detailing 10% increase in federal R&D for 1992).

75. EPA commands great leverage with its sweeping regulations, such as the requirements for environmental impact statements, labelling, and disclosure of chemical output to public data banks under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). Elliott, *supra* note 40, (discussing EPCRA, 42 U.S.C. §§ 1101-50 (1988)). Product liability, tax, patent, antitrust, and merger laws further affect R&D incentives.

76. For example, the United States Global Change Research Program coordinates its activities with organizations such as the International Council of Scientific Unions and the United Nations. COMMITTEE ON EARTH AND ENVIRONMENTAL SCIENCES, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, OUR CHANGING PLANET: THE FY 1991 U.S. GLOBAL CHANGE RESEARCH PROGRAM 143-49 (1991) [hereinafter USGCRP FY 91]. The global nature of the problems demands cooperation. When national legislation is comparatively strict, the United States can also be spurred by competitive disadvantage to seek an international environmental policy, encouraging research worldwide. Under pressures of competitive disadvantage, CFC industries in the United States became instrumental in the nation's leadership in developing the Montreal Protocol. RICHARD E. BENEDICK, OZONE DIPLOMACY 69, 80 (1991).

4. *Potential Bureaucratic Problems*

Risk based budgeting may pose bureaucratic problems if prioritization schemes produce excessive formal analysis, excessive coordination, or excessive costs deriving from rapid agenda changes. If formal analytical schemes for priority setting are extended too far, risk based budgeting can illustrate Parkinson's "Law of Triviality," which satirizes budget committees: "[T]he time spent on any item of the agenda will be in inverse proportion to the sum involved."⁷⁷ The focus on budgetary trivia is illustrated by one early "formal" attempt at prioritizing within individual research programs, including an attempt to set priorities among the criteria of prioritization themselves. The Subcommittee on Natural Resources, Agriculture and Environment recently considered the prioritization of research projects within the program of pollution prevention. This portion of the research budget, amounting to a mere \$11 million, was apparently allocated according to a system of eight factors: "Overall environmental impacts, potential cost effectiveness of proposed activities, degree of need for information, importance of EPA's contribution in the area, ability to achieve near-term results, and so on."⁷⁸ Further inquiry focused on the *ranking* of these factors themselves. The ORD witness described the highest priority criterion rather generally as "the impact upon human health and the environment." Other factors were themselves ranked qualitatively and applied to each pollution prevention project.⁷⁹ A decisionmaker in this maze of abstract formality would only be led in circles, however, because general goals—such as effectiveness, importance, and informativeness—have been confused with the criteria for judging their achievement.⁸⁰

If extended too far, risk based schemes can also result in excessive coordination. Coordinating arrangements may be suspect as potential "gimmicks" that repackage and market existing programs to attract or simulate new funding.⁸¹ Coordination may also interfere with the research efforts of scientists by increasing the number of meetings they must attend.⁸²

77. C. NORTHCOTE PARKINSON, *PARKINSON'S LAW* 63 (1957).

78. *EPA R&D FY 91 Hearing*, *supra* note 14, at 29 (questions of Howard Wolpe, D-Michigan, Subcommittee member; response of Erich Bretthauer, Assistant Administrator, ORD).

79. *Id.*

80. One cannot evaluate the relative need for certain research information on the basis of the "need for information." *Id.* Nor can one evaluate the importance of EPA's contribution on the basis of the "importance of EPA's contribution." *Id.* "Near-term results," *id.*, are in no way self evidently more valuable than long term research—if anything, long term vision distinguishes the ORD from other, strictly regulatory offices. Evaluating the relative "impact upon human health and the environment," *id.*, only begs the question of how different kinds of impacts should be compared.

81. Telephone Interview with Robert W. Niblock, Oceans and Environment Program Manager, Office of Technology Assessment (May 14, 1991) [hereinafter Niblock Interview] (expressing skepticism about certain scientific and institutional proposals for reforming prioritization).

82. *Cf.* Telephone Interview with Hassan Virji, Assistant to Director of Geoscience, National Science Foundation (May 13, 1991) (acknowledging that such meetings have certainly multiplied, but arguing that program was both young and unique, and that evaluation would have to wait); *infra* notes 119-128 and accompanying text (discussing USGCRP).

The costs of changing agendas must also be taken into account in implementing risk based budgeting. According to Kenneth Arrow, the cost of processing information discourages organizations from changing their agendas. Increasing the scale of the agenda requires further specialization, which produces ever-increasing complexity and higher communication costs. By changing agendas, the agency also wastes its existing codes of communication and other capital investments already made for sharing specialized information.⁸³ Furthermore, the demand for new items may be limited by their uncertain value.⁸⁴ Government bureaus sometimes develop precisely this risk aversion when responding to the demands of a critical electorate: they budget conservatively and prefer projects with certain and measurable outcomes.⁸⁵

Changing budgetary agendas to reflect scientific findings also poses accounting problems, since changing the budgetary agenda impedes comparison of the budgets of different fiscal years. Although the well-established classification of environmental legislation and budgeting does not accommodate scientific changes, members of Congress and their staffs often prefer to see a similar classification from fiscal year to fiscal year so as to compare changes.⁸⁶

Although risk based budgeting is a promising idea, budget decisionmakers should also consider other policies. Analysis of bureaucratic issues—like analysis of responsibility and resource allocation, risk reduction, risk distribution, and uncertainty—should complement comparative risk analysis in reforming EPA research priorities.⁸⁷ The next Part offers suggestions for expanding risk based budgeting.

83. KENNETH J. ARROW, *THE LIMITS OF ORGANIZATION* 59 (1974). Conversely, when pursuing their *existing* agendas, organizations use information more efficiently than individuals. Organizations are well structured to monitor alternative items for agendas, especially when these are strongly demanded by a crisis, or easily supplied by fortuitous research overlaps and staff turnover. *See id.* at 52-53, 59.

84. *Id.* at 41.

85. DENNIS C. MUELLER, *PUBLIC CHOICE* II 258 (1989); *cf.* JAMES Q. WILSON, *BUREAUCRACY* 69-70, 191 (1989) (describing similar bureaucratic risk aversion). Capital communication costs and uncertainty lead Arrow to mention a "tendency to hive off incompatible functions into new organizations." ARROW, *supra* note 83, at 58. He mentions the tendency descriptively, in passing, after describing normative suggestions of other theorists that military R&D should be placed under civilian control and that scientific management should be separated from budgetary control. (The vision of this "need" for the separation of new agendas into new agencies is ascribed to Franklin D. Roosevelt.) *Id.* at 57-58. After Arrow's diagnosis, however, we may well ask whether the treatment he prescribes *en passant* is an adequate alternative.

86. Veirce Interview, *supra* note 16 (describing problems as ORD program analyst "wearing two hats" of scientific training and financial experience). For example, some Agency staff, disgruntled with President Carter's "zero-based budgeting," refer to the added responsibility as accounting "down to the last peanut." *Id.*; *see supra* note 39 (explaining "zero-based budgeting").

87. *Cf.* Blomquist, *supra* note 5, at 179-88 (discussing relationship between risk and other general environmental policy issues).

IV. INSTITUTIONAL AND POLICY AUGMENTATION OF RISK BASED BUDGETING LEGISLATION

Environmental research budgeting reforms should accommodate institutional and policy factors, to develop more fully the systematic and comprehensive potential of risk based comparisons and to specify the diverse range of criteria and values on which reasoned prioritization depends.

A. *Bilateral Delegation to Congressional Experts*

In order to prevent the increase of executive influence over scientific matters, authority for risk based priority setting should not be delegated solely to specialists in the Executive. Instead, Congress should delegate “bilaterally” to specialists in both Congress and the Executive. Bilateral delegation would shift power in the Executive away from OMB to EPA and its ORD and SAB, and in Congress, away from the appropriations committees to the environmental science committees, with possible contributions from the congressional Office of Technology Assessment (OTA).

Such bilateral delegation would increase participation and decrease potential domination by either branch in policy debates. Congress should enhance the budgetary role of congressional science committees and executive science offices, not as a way to create adversarial relationships between branches of government, but to minimize the opportunities for manipulative advantage and to equalize incentives to reach a consensus on scientific matters.⁸⁸ Shared involvement by the Congress and the Executive would also synergistically combine their respective expertise in political and administrative matters.

Bilateral delegation would also increase the representation of constituencies of different scales. Direct congressional representation may be desirable when decisions require representation of state or congressional district interests. Presidential accountability and a national mandate may be preferable to coordinate assessment and comparison of aggregate risks on a national scale, and to challenge or veto congressional priorities otherwise uninformed by scientific expertise or coordinated oversight.⁸⁹ Bilateral delegation, and hence equally informed bilateral representation, would be particularly valuable in decisions about the distribution of risk, which involve judgments about research of widely varying scales.

88. See JASANOFF, *supra* note 6, at 250 (1990) (concluding that negotiation about scientific issues commits parties to moderate their views in regulatory context); see also *supra* note 569 (noting politicization of advisory committees). Of course, bilateral delegation invites the political capture of specialist agencies and committees because this policy increases the stakes of the scientific debates in which they engage. But shifting from budgetary politics to science does situate the debate on a more relevant battlefield.

89. See Mashaw, *Prodelegation*, *supra* note 41, at 95-96, 98 (describing President’s national mandate; arguing for delegation to account for “situational variance”).

Two ways for decisionmakers to attempt to increase scientific influence over EPA research priority setting are suggested here. First, the House Committee on Science, Space and Technology and the Senate Committee on Environment and Public Works should attempt to determine environmental research priorities themselves, drawing on and deferring to the expertise of their specialized environmental subcommittees and scientific staff.⁹⁰ The House Subcommittee on Environment and the Senate Subcommittee on Toxic Substances, Environmental Oversight, and Research and Development could seek to mandate priorities by making scientific findings and drafting substantive legislation that might survive the revisions and line-items of appropriations legislation.⁹¹ Legislation could be designed to specify budgetary priorities in the form of *proportions* or *ratios* of the budget which would persist regardless of the actual amounts of budgetary appropriations, along the lines of the recent mandate for the expenditure of at least 15% of certain appropriations for continuing and long term environmental research and development.⁹²

The recommendation to legislate budgetary priorities per se finds some support in Supreme Court jurisprudence. In *Tennessee Valley Authority v. Hill*,⁹³ the doctrine of "disfavoring repeals by implication" was invoked to prevent statutory priorities from being repealed incidentally in the course of other legislation, including budgeting legislation. The Court held the scope of appropriations bills to be limited by express rules of both Houses to the effect that appropriations measures may not change existing substantive law.⁹⁴ Although the appropriations committees had continuously allocated funds for the almost completed TVA dam, the substantive "priority" set by the Endangered Species Act of 1973⁹⁵ protected the snail darter fish and prevented completion

90. Cf. Roger H. Davidson, *Subcommittee Government: New Channels For Policy Making*, in THE NEW CONGRESS 118-24 (Thomas E. Mann & Norman J. Ornstein eds., 1981) (discussing "jurisdictional" politics); C. Lawrence Evans, *Influence in Congressional Committees: Participation, Manipulation, and Anticipation*, in CONGRESSIONAL POLITICS 155 (Christopher J. Deering ed., 1989); David P. Hamilton, *Brown Picks Old Faces For a New Team*, 251 SCIENCE 377 (1991) (describing appointments of expert scientific staff by chair of House Committee of Science, Space, and Technology). Compare Davidson, *supra*, at 99, 106-08, 115-18 (describing increasing tendency toward subcommittee government, especially within House Democratic Party in 1970's and early 1980's) and Richard L. Hall, *Committee Decision Making in the Postreform Congress*, in CONGRESS RECONSIDERED 197-220 (Lawrence C. Dodd & Bruce I. Oppenheimer eds., 4th ed. 1989) (describing decentralized process) with Lawrence C. Dodd & Bruce I. Oppenheimer, *Consolidating Power in the House: The Rise of a New Oligarchy*, in CONGRESS RECONSIDERED, *supra*, at 39-61 (describing and assessing development of centralized majority party leadership and elite committees).

91. See, e.g., Letter from George E. Brown, Jr., Chairman, House Committee on Science, Space, and Technology, to *Science*, in 252 SCIENCE 629 (1991) [hereinafter Brown Letter] (announcing intention of his House Committee to set priorities for federal R&D comprehensively and systematically).

92. 42 U.S.C.A. § 4363 (West Supp. 1992).

93. 437 U.S. 153 (1978).

94. 437 U.S. at 189-91; see also Cass R. Sunstein, *Interpreting Statutes in the Regulatory State*, 103 HARV. L. REV. 405, 456-57 & nn.183-84 (1989) (discussing interpretation of appropriations measures that alter substantive statutes).

95. 16 U.S.C. § 1536(a) (1976), amended by Pub. L. No. 96-159, § 4(1), 93 Stat. 1225, 1226 (1979) (current version at 16 U.S.C. § 1536(a)(1) (1988)).

of the dam.⁹⁶ The case demonstrates that environmental priorities can be set independently of appropriations committees.

Second, risk based budgeting should involve new roles for scientific agencies in both the Executive and Congress, namely, the executive Office of Research and Development (ORD), the Science Advisory Board (SAB) in the EPA, and the congressional Office of Technology Assessment (OTA).

The SAB currently reviews ORD priorities, but with ambiguous authority. At recent hearings of the Subcommittee on Natural Resources, Agriculture Research and Environment, ORD announced that it was "moving toward a new planning process that w[ould] define EPA's research program around a set of risk based issues."⁹⁷ The SAB summarily "applaud[ed] ORD's continuing efforts"⁹⁸ and officially described themselves as "pleased,"⁹⁹ while privately some SAB officials wondered when the results of their *Reducing Risk* study would be fully incorporated in the President's budget. SAB officials usually defend ORD's requests for funds from Congress, even as they attempt to monitor and reform ORD's allocation of those funds. Some recommend that Congress mandate and fund an SAB comparative risk study every two years.¹⁰⁰

Congress should commission contributions to the debate by its own experts in the OTA to avoid dependence on executive agencies and to augment the policy debate. OTA is a relatively small, analytic agency for Congress that has notable experience in evaluating individual environmental programs—such as the Department of Defense's nuclear waste disposal projects¹⁰¹—and federal research policy, for which they have drawn rare praise.¹⁰²

OTA researchers have never been directly asked to compare the relative merits of different programs. Moreover, they expect little interest from congressional committees in such comparative questions, which tend to cross the lines of individual committees' jurisdictional areas of interest.¹⁰³ The approach of OTA scientists if Congress did pose the comparative question to them would probably be to address directly the policy issues inherent in risk based budgeting, treating quantitative comparative risk assessment as but one of many useful analytical methods. Finally, OTA would likely proceed by assembling a variety of experts and synthesizing outside concerns from their own perspective, along

96. 437 U.S. at 194.

97. *EPA R&D FY 92 Hearing*, *supra* note 1 (statement of Erich W. Brethauer, Assistant Administrator, EPA Office of Research and Development).

98. John Neuhold, *Cover Letter to SAB FY 92 REVIEW*, *supra* note 45, *reprinted in EPA R&D FY 92 Hearing*, *supra* note 1, at 76.

99. SAB FY 92 REVIEW, *supra* note 45, at 4, *reprinted in EPA R&D FY 92 Hearing*, *supra* note 1, at 86.

100. Rondberg Interview, *supra* note 8.

101. OFFICE OF TECHNOLOGY ASSESSMENT, OTA-O-484, *COMPLEX CLEANUP: THE ENVIRONMENTAL LEGACY OF NUCLEAR WEAPONS PRODUCTION* (1991) [hereinafter *COMPLEX CLEANUP*].

102. OFFICE OF TECHNOLOGY ASSESSMENT, OTA-SET-490, *FEDERALLY FUNDED RESEARCH: DECISION FOR A DECADE* (1991); Brown Letter, *supra* note 91 (describing OTA-SET-490 as "probably the most comprehensive and balanced analysis of federal R&D policy produced to date").

103. Niblock Interview, *supra* note 81.

the lines of the OTA review of National Energy Strategy in the late 1970's in which it summoned 30 to 40 panels of affected parties, technical experts, academics, and leaders of public opinion.¹⁰⁴ Such participation would add diverse and important perspectives to the risk based budgeting process.¹⁰⁵

In delegating to scientific committees, legislators might simultaneously reconsider constraints on the delegation of judgments to scientific advisory boards performing studies or coordinating roles in both branches.¹⁰⁶ Short of cumbersome legislation requiring a specificity reviewable in court, statutes might require SAB and OTA to identify methodological and policy assumptions explicitly in final reports.¹⁰⁷

B. Addressing Policy Issues

Reform proposals should also address the policy issues that inform and complement budgeting on the basis of risk, including uncertainty, equity, risk-reduction, responsibility, resources, and bureaucracy.

1. Monitoring For Scientific Uncertainty

In the face of uncertainty, a variety of exploratory approaches should be adopted in order to monitor potential risks, including those of error and ignorance. Alternative ways to translate comparative analysis into budgetary terms include reflecting relative risks (1) as varying proportions of funding, or (2) as a time-ordered series of projects on a calendar. The serial approach allows policy makers to devote more resources at a given time to certain priorities, but may postpone others indefinitely. The proportional approach allows both a wider initial choice of priorities and monitoring of alternative potential priorities, but

104. *Id.*

105. OTA's general skepticism about the value of risk assessment research is revealed by the many warnings enunciated in its recent report on the proposed cleanup of defense nuclear waste. The costs have been projected to reach \$155 billion, including an initial five years of research and development. COMPLEX CLEANUP, *supra* note 101, at 60-64 (1991) (criticizing Department of Energy "risk based" budget priority system); *id.* at 55-59 (discussing estimates while further noting likelihood of underestimation by 25% -100% in environmental restoration projects). This research, according to OTA, would generate "mounds of paper studies without so much as a spade-full of action," and still leave regulators "without necessarily knowing what to dig, and still needing to know before digging." Niblock Interview, *supra* note 81.

106. Legislation already governs the formation and governance of scientific advisory boards. Federal Advisory Committee Act of 1972 (FACA), 5 U.S.C. app. §§ 1-15 (1988); Government in the Sunshine Act, 5 U.S.C. § 552b (1988); *see also* Nicholas A. Ashford, *Advisory Committees in OSHA and EPA: Their Use in Regulatory Decisionmaking*, in 9 SCI., TECH. & HUM. VALUES 72, 73, 76-79 & nn. 1 & 16 (1984) (discussing expert and democratic roles—and abuse—of advisory committees; analyzing FACA requirements for "fair balance" in legislative history as balances of competence, technical discipline, and allegiance, in contrast with political replacement of almost 60 SAB members in 1983). *See generally* JASANOFF, *supra* note 6, at 32-36 (discussing "congressional ambivalence" about scientific advice given at EPA by Science Advisory Board, Clean Air Scientific Advisory Committee, and Science Advisory Panel).

107. Scientific committees and their leadership may vary in their own conception of the role and reliability of science. While such different approaches may be detailed in committee studies, they may not be as apparent in the summary form of final reports, *see supra* note 56.

may spread resources too thinly. Given the scale and uncertainty of environmental research, it is imperative to strike a careful balance between serial and proportional prioritization, so as to ensure not only ordered responses to known risks, but also discovery of those remaining unknown.¹⁰⁸ The risk of failing to discover environmental risks should also be diversified: while priorities must be set, alternative lines of research should be sufficiently monitored.¹⁰⁹

2. *Considering the Equality of Risk Distribution*

The equality of risk distribution should be carefully considered as priorities are set. Attention to the issue of equality is especially important in the research context, because the very distinctions between predictable and unpredictable as well as between concentrated and diffuse risks are difficult to define and thus raise complex questions of epidemiology. Risks from genetic predisposition may be more difficult to predict than those from geographical or industrial exposure to hazardous substances but are no less deserving of funds. Indeed, such diffuse groups are arguably in special need of protection.¹¹⁰ Furthermore, the greater the predictability and concentration of a given risk, the greater the likelihood of countervailing benefit from such a risk, and the greater the degree of choice or knowledge that may be available—or should be made available—to the group at risk.¹¹¹

The unresolved and competing considerations of policy and justice that are relevant to comparisons of aggregate and average risks borne by population groups of different sensitivities and scales should be discussed in a forum allowing diverse representation or participation. Bilateral delegation would allow the President and Congress to represent national and regional interests, respectively, thus increasing the equity of federal environmental research budgeting.

108. For example, the Administrative Conference of the United States has recommended that agencies experiment with a "phase system" of reducing options. Initially, the agency should "identify as large a number of options as it can for brief study. As options are considered and rejected, the remaining options should be analyzed with increasing thoroughness. As resource constraints preclude further consideration . . . the agency should explain briefly . . . why the option did not warrant further study." 1 C.F.R. § 305.85-2(1)(b) (1992).

109. Cf. generally BURTON G. MALKIEL, *A RANDOM WALK DOWN WALL STREET* 221-28 (5th ed. 1990) (simplifying portfolio theory of investment, citing HARRY MARKOWITZ, *PORTFOLIO SELECTION; EFFICIENT DIVERSIFICATION OF INVESTMENTS* (1959)).

110. See Bruce A. Ackerman, *Beyond Carolene Products*, 98 HARV. L. REV. 713, 742 (1985) (arguing that rights of diffuse, anonymous majorities are underrepresented in politics and require extension of the constitutional protection historically necessary for discrete and insular minorities).

111. Occupational hazards are a typical example of concentrated risks of which the benefits, choice, and even knowledge, are not, in fact, always fully available to the particular group exposed. Cf. Hornstein, *supra* note 5, at 597-98; CALABRESI & BOBBIT, *supra* note 67, at 24-26 (1978) (regarding equality as culturally variable guide to making tragic allocation choices; regarding honesty as indispensable for legitimation of such choices).

3. *Comparing Alternative Risk Reduction Methods and Reallocating Responsibility and Resources*

Risk based budgeting should also be augmented by comparisons of alternative risk reduction methods and reallocations of responsibility and resources. For instance, while ozone research funds might ultimately reduce aggregate risks to more people than those devoted to cleaning certain hazardous waste sites, there is no logical necessity to ignore toxic waste programs. Less expensive alternatives to cleaning may be available, including containment of leakage, assistance in relocation, or at the very least testing and warnings. There is also no need to sacrifice EPA research on toxic waste for the sake of research on ozone protection if global issues might be better pursued by economic regulation or with a shared, interagency or international budget. Comparison of alternative risk reduction methods is necessary for a proper comparison of research programs.

At times, agency priorities should not shift, but resources should be increased or responsibilities reallocated. New tasks often require new funds.¹¹² Line items should be limited in size or proportion, if they cannot be banned outright at certain stages of the budgetary process. Certainly "when funds are earmarked for special programs additional monies [should] be appropriated to accommodate them."¹¹³ Revenues may be raised and disbursed and responsibilities reallocated even without budgetary authorization, such as by research and development tax credits and requirements for matching funds.¹¹⁴ Resources and responsibilities may need to be diverted from other areas. For example, discretion and flexibility for researchers in the administration would be enhanced by freeing them from some of their responsibilities to regulators through independent research titles, by improving the ratio between funds earmarked for basic and applied research,¹¹⁵ or by increasing the ORD/EPA budgetary ratio.¹¹⁶ Meanwhile,

112. While this problem is faced by all new, initially "soft" legislation, funds often follow programs. See WILDAVSKY, *supra* note 39, at 115 (quoting Representative Rooney's description of \$250 item as "the camel's nose," which reveals itself to be large animal after entering the tent (i.e., the budget)).

113. SAB FY 92 REVIEW, *supra* note 45, at 6, reprinted in EPA R&D FY 92 Hearing, *supra* note 1, at 88.

114. General R&D tax credits, or perhaps tax credits specifically accompanying grants, could serve as a similar substitute in the case of private corporations receiving grants. See LEDERMAN, *supra* note 45, at 19 (recommending "trust fund supported by special taxes on high technology" and "government bonds, designated for research, with interest keyed to the returns on that research"); see also *supra* notes 72-71 and accompanying text. Matching fund requirements may bind private money to governmental spending conditions, although the amount of such privately affected funds may be limited in some ways. Compare, e.g., 42 C.F.R. § 59.8(a) (1991) (prohibiting abortion counseling by clinics receiving Title X family planning grants) with 42 U.S.C. §300a-4 (1988) (requiring of HHS that "no [Title X] grant . . . after June 30, 1975 . . . be made for less than 90 per centum of its costs").

115. Cf., e.g., *supra* note 92 and accompanying text.

116. Cf., e.g., FEDERAL R&D, *supra* note 73, at 1-6 (revealing increase in proposed ratio between energy research and total energy budget, from 52% in 1990 to 85% in 1991, despite 5% net cut of energy R&D funds in absolute terms).

to police procurement and grant misuse, funds for auditing, penalties, or (for this limited purpose) judicial review should be increased.¹¹⁷

An important example of coordinating responsibilities and resources for environmental research prioritization can be found in the interagency United States Global Change Research Program (USGCRP).¹¹⁸ Since the early 1980's, USGCRP has coordinated research on the earth sciences across five departments and four agencies.¹¹⁹ Control is centralized in the Executive,¹²⁰ albeit with some conflict,¹²¹ and is unencumbered by direct legislation and congressional control.¹²² Since 1990, an interdisciplinary priority framework has structured a five year research plan for USGCRP.¹²³ A recent USGCRP budgetary report elaborates a theme of agency "cooperation," in an "integrated, comprehensive" and "interdisciplinary" program, as environmental research projects proceed "simultaneously and in concert . . . [as] mutually reinforcing,"¹²⁴ with a "balance between ground- and space-based research activities."¹²⁵ EPA shares of this research budget suggest that coordination may well result in vastly different degrees of responsibility among the agencies involved. In 1990, the annual budget coordinated by USGCRP rocketed more than five-fold to include NASA's Earth Observing System and Satellites, now launched as "Mission to Planet

117. Agency auditing is rather constrained. Veirce Interview, *supra* note 16 (explaining dependency on grantees for "colorable estimates" of actual expenditures and research directions; estimating that potential problems of abuse were outweighed by cost of the 20% increase in personnel that would be required for a significant increase in oversight); *see also* Eliot Marshal, *Tiger Teams Draw Researchers' Snarls*, 252 SCIENCE 366, 366-68 (describing Department of Energy inspection forces and questioning whether costs of compliance outweigh risks reduced).

118. 15 U.S.C. §§ 2931-37 (Supp. II 1990).

119. These are the Departments of Agriculture, Commerce (National Office of Air Administration), Defense, Energy, and the Interior (U.S. Geological Survey); the agencies are EPA, NASA, the National Science Foundation, and the Smithsonian. USGCRP is but one of about 13 working groups under the Committee on Earth and Environmental Sciences (CEES), which is centered at the U.S. Geological Survey (USGS) in the Department of Interior. CEES is one of seven committees under the Federal Coordinating Council for Science and Engineering Technology (FCCSET, pronounced "Fixit"), which is administered from the executive Office of Science and Technology Policy (OSTP).

120. For example, in 1991, Dr. D. Allen Bromley, the chairman of FCCSET, was also Director of OSTP (following 42 U.S.C. § 6651(c) (1988)) and Science Advisor to the President. The chairman of CEES, Dr. Dalles Pack, was also Director of USGS.

121. *See, e.g.*, David P. Hamilton, *FCCSET Under Fire*, 252 SCIENCE 1365 (1991) (describing Interior Secretary Lujan's resistance to early requests for budget data by FCCSET); *The High and Mighty*, 255 SCIENCE 19 (1992) (rumoring possible departure of Science Advisor Bromley from future administration due to conflict with OMB).

122. Telephone Interview with Tom Watts, Office of Management and Budget (May 14, 1991). FCCSET was originally established under 42 U.S.C. § 6651 (1988), but has been abolished and its functions (presumably including CEES and USGCRP under 42 U.S.C. §§ 2932(a), 2934(a) (1988)) have been transferred to the President since Reorg. Plan No. 1 of 1977, 3 C.F.R. at 197, 198 § 5A (1977), *reprinted in* 5 U.S.C. app. (1988), as provided in Exec. Order No. 12,039, 3 C.F.R. at 139 (1979), *reprinted in* 42 U.S.C. § 601 (1988). *See also* Charter, Committee on Earth Sciences, *reprinted in* COMMITTEE ON EARTH AND ENVIRONMENTAL SCIENCES, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, OUR CHANGING PLANET: THE FY 1990 U.S. GLOBAL CHANGE RESEARCH PROGRAM 29 [hereinafter USGCRP FY 90].

123. USGCRP FY 91, *supra* note 76, at 13 (depicting priority framework in elaborate diagram).

124. COMMITTEE ON EARTH AND ENVIRONMENTAL SCIENCES, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, OUR CHANGING PLANET: THE FY 1992 U.S. GLOBAL CHANGE RESEARCH PROGRAM 5 [hereinafter USGCRP FY 92].

125. *Id.* at 8.

Earth," with a new focus on global change.¹²⁶ The President's 1992 request for the nine recipients of USGCRP funding was approximately \$1.2 billion, with almost two thirds of this sum earmarked for space based research by NASA, and only \$26 million requested for EPA's ORD.¹²⁷ The NASA lion's share of \$772.6 million is about fifteen times larger than the average of \$51.6 million for each of the other eight agencies involved. The Earth Observation System (EOS) may provide NASA with a new environmental purpose and alleviate the responsibilities of offices such as ORD, even though, so far, planning for the program has not inspired the confidence of congressional analysts.¹²⁸

Critical masses, the minimum budgetary requirements of any particular program, are, like priorities themselves, a substantive consideration, affecting the very efficacy or superfluity of a program. Rather than allowing priorities to be excessively determined by appropriation levels and line items, legislation should specify ratios and minimum, critical masses. If lower priorities are not deemed worthy of maintaining critical mass at the expense of needed increases in higher priority areas, contingent legislation could revise allocation priorities, delete the small program entirely, and redistribute funds across remaining priorities if critical mass is lost.¹²⁹ Budget categories should thus be classified as interdependent, so that proposed increases for high priority areas are not obtained at the expense of the critical mass needed by programs with a lower profile and so that programs funded below critical mass do not drain resources.¹³⁰

4. Moderation in Agenda Reform

Agenda reform toward and beyond risk based budgeting should proceed at a moderate pace to mitigate potential bureaucratic problems. Changes in agenda directly affect the working lives of agency staff by adding new responsibilities, for which the Agency may be answerable in Congress or court, and by displacing traditional centers of legislative and agency power. The costs of

126. Compare USGCRP FY 91, *supra* note 76, at 160 with USGCRP FY 90, *supra* note 122, at 24-25 (revealing dramatic, unprecedented increase in NASA share of USGCRP with advent of Earth Observing System).

127. USGCRP FY 92, *supra* note 124, at 19.

128. See Eliot Marshall, *Accountants Fret Over EOS Data*, 255 SCIENCE 1206 (1992) (reporting criticisms of EOS planning in recent GAO report and house hearing), citing GENERAL ACCOUNTING OFFICE, IMTEC-92-24, EARTH OBSERVING SYSTEM: NASA'S EOS DIS DEVELOPMENT APPROACH IS RISKY (1992).

129. The EPA Administrator's standard reprogramming authority, *see supra* note 14, may be too limited for this purpose, *see Roberts, supra* note 2, at 618 (reporting estimate that Administrator effectively retains discretion over only 5% of EPA budget).

130. Cf. *supra* text accompanying note 91 (proposing substantive priority setting by congressional committees). Contrast the Budget Enforcement Act of 1990, 2 U.S.C.A. § 900(4)(A) (Supp. 1992), which, conversely, classifies budgetary categories of domestic, defense, and foreign assistance *independently* for reconciliation purposes, such that certain *reductions* in one category cannot be used to *increase* the allotment in another. For example, cuts in foreign assistance cannot fund domestic education. See Colin Norman, *Science Increases Will Test New Regime*, 251 SCIENCE 617 (1991) (noting implications of Budget Enforcement Act for R&D funding).

changing everyday accounting methods and styles of oversight can be felt in very job-specific ways. "You'd have people going crazy or leaving; you need a certain protectionism in the buffeting of political winds." One "boss from the outside," encountering the civil service from a fresh, managerial perspective, reportedly described the difficulties of making necessary changes: "[I]t's like flying a B-29 in a dogfight—sure takes a long time to turn. [Success] depends on how fast you turn the corners."¹³¹ While changes are needed, ORD staff hope that it is neither too radical, nor subsequently too fixed. One proposal made in preliminary discussions contemplated forty to fifty alternative budgetary categories so that the budget would better reflect risk categories. Staff who would have to reorganize program budgeting and monitoring to reflect these changes would prefer a tenth of the shift: four to five new areas a year.¹³²

The prospects for the adoption of risk based budgeting may depend on the form such legislation takes. Risk based budgeting for research has more chance of success as an amendment but more to gain as a freestanding bill. For example, new research titles have been created as amendments to individual environmental acts. The Clean Air Act Amendments of 1990, while necessitating additional regulatory research, incorporate a significant new research title for "[r]esearch, investigation, training, and other activities."¹³³ This title includes authorization for research in environmental health, ecosystems, and a renewal of the NAPAP interagency acid rain program, as well as research in methodology and pollution prevention. However, insofar as agenda shifts toward basic, exploratory, and preventative research are desired, they will be more responsive to agency supported scientists if they have their own research title. A more ambitious strategy than the amendment of existing legislation would be to pass a new, freestanding environmental research bill such as ERDDA of 1978 (which gave the Science Advisory Board its mandate),¹³⁴ Congressman Ritter's more recent CERMA bill,¹³⁵ or Senator Moynihan's Environmental Risk Reduction Act.¹³⁶ Proposals for new interagency boards or programs tend to fail, however, when they attempt (or threaten) to do too much. For example, the defeated bill proposing a Risk Assessment Research and Demonstration Act of 1983 was unanimously opposed by five affected departments and agencies.¹³⁷

131. Veirce Interview, *supra* note 16.

132. *Id.*

133. 42 U.S.C. § 7403 (West Supp. 1984-1990).

134. Environmental Research, Development, and Demonstration Authorization Act of 1978, 42 U.S.C. § 4365 (1988).

135. H.R. 5435, 100th Cong., 2d Sess. (1988) (proposing Comprehensive Environmental Risk Management Act).

136. S. 2132, 102d Cong., 1st Sess. (1991). For further discussion of this bill, see text accompanying notes 35-36.

137. H.R. 4192, 98th Cong., 1st Sess. (1983). Opposing submissions by EPA, OSHA, CPSC, FDA, and FSIS are appended to *H.R. 4192, The Risk Assessment Research and Demonstration Act of 1983: Hearings Before the Subcomm. on Natural Resources, Agriculture Research and Environment of the Comm. on Science and Technology, U.S. House of Representatives*, 98th Cong., 2d Sess. 289, 402, 430, 444 (1984).

Agendas should be changed in Congress and the Executive, but gradually, without excessive subclassification, coordination, or bureaucratic costs. While the agency has begun using “buzzwords” such as “risk based budgeting,” reform will probably take some time.¹³⁸

CONCLUSION

Quantitative comparisons promise a systematic, comprehensive specificity that should indeed inform environmental research priority setting. Though science informs policy choices, however, it cannot make them. Because comparative risk analysis provides a necessary but insufficient basis for reforming EPA research priorities, the current proposals for risk based budgeting approach should be augmented and refined. Offices within both Congress and the Executive should participate in the setting of priorities, and in so doing, these policymakers should pay close attention to fundamental methodological questions and values. These reforms, by facilitating greater participation in scientific debates as well as a greater diversity of policy languages, should increase the overall resistance of science to political capture and thus enhance the value of risk analysis in planning EPA’s research.¹³⁹

138. Niblock Interview, *supra* note 81.

139. *Cf. generally* GEORGE STEINER, *AFTER BABEL: ASPECTS OF LANGUAGE AND TRANSLATION passim* (1975) (appreciating languages for their diversity rather than for their possible universal structure); *Genesis* 11:7-9 (narrating how unitary language enabled construction of a “tower with its head in the heavens” until language was diversified by God for potential abuse of power at Babel).

