RETHINKING HEALTH-BASED ENVIRONMENTAL STANDARDS

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Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) is required to determine the stringency of the National Ambient Air Quality Standards (NAAQS), arguably the most important federal environmental program, without considering the costs of achieving these standards. Instead, it must rely exclusively on health-related criteria. This Article argues that health-based standards, which are one of the principal approaches to setting the stringency of environmental requirements in the United States, exhibit two serious pathologies: the stopping-point problem and the inadequacy paradox. The stopping-point problem arises because there is no coherent, defensible way for EPA to set the permissible level of pollution based on health considerations alone. Moreover, contrary to the commonly accepted view, the NAAQS have generally been set at levels that are less stringent than those that would result from the application of cost-benefit analysis, giving rise to the inadequacy paradox. We urge a reinterpretation of the Supreme Court's important decision in Whitman v. American Trucking Associations *to avoid the inadequacy paradox.*

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INTRODUCTION

Whitman v. American Trucking Associations[1] is understood across the political spectrum to hold that the U.S. Environmental Protection Agency (EPA) may not consider costs when setting National Ambient Air Quality Standards (NAAQS) under the Clean Air Act (CAA). This decision was lauded by protection-oriented groups as a major victory for public health and the environment,[2] and

[1] 531 U.S. 457 (2001).

[2] *See, e.g.*, Editorial, *Clean Air—and Congress—Wins*, WASH. POST, Feb. 28, 2001, at A24 ("[T]he court handed public health a major victory . . . ."); *Clean Air Wins*, EARTH ISLAND J., Autumn 2001, *available at* http://www.earthisland.org/journal/index.php/eij/article/positive_notes3 ("American Lung Association CEO John R. Garrison called the decision 'a victory [for] the Clean Air Act and for the health of the American People.'"

severely criticized by regulated industry and anti-regulatory groups for imposing burdensome costs in pursuit of unrealistic levels of environmental safety.[3] Both sides therefore seem to agree that were EPA to engage in cost-benefit analysis of its proposed air quality standards, the results would be more industry friendly and less environmentally protective.

This conventional account is widely shared in the academic literature. Advocates of cost-benefit analysis have decried health-based standards as an "absolutist commitment to a zero-risk level" that can be not only "unduly expensive," but also "counterproductive."[4] On the other side, "cost-blind" standards have been praised for putting "a thumb on the scale in favor of the weaker party."[5] Despite their many differences, both academic camps share the view that cost-benefit analysis would act as a check on regulation that would otherwise provide stronger levels of environmental protection.

This conventional account gives rise to two interrelated pathologies. We call the first the stopping-point problem. Environmental pollutants often lack ambient concentrations below which there is no risk

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(alteration in original)); *Earthjustice Legal Defense Fund: Supreme Court Upholds Clean Air Standards Against Industry Attack*, U.S. NEWSWIRE, Feb. 27, 2001 ("The Supreme Court has upheld the Clean Air Act's central mandate to protect the public health against pollution that kills tens of thousands of people each year . . . ." (quoting Howard Fox of Earthjustice Legal Defense Fund)); Frank J. Murray, *Clean-Air Ruling Hits Big Business Supreme Court Says, EPA Standards Not Limited by Cost*, WASH. TIMES, Feb. 28, 2001, at A1 ("The Supreme Court has agreed with the fundamental principle that the Clean Air Act is designed to protect people's health without regard to cost." (quoting Frank O'Donnell of the Clean Air Trust)).

[3] *See, e.g.*, Katherine A. Kelley, *MMS Shop Talk*, MODERN MACHINE SHOP, Apr. 30, 2001, at 42 (relating the "profound disappointment" of the National Association of Manufacturers); John S. McClenahen, *Court Rejects Cost Argument*, INDUS. WEEK, Mar. 19, 2001, at 11 (noting that the Chamber of Commerce "vows to carry the fight to Capitol Hill"); Murray, *supra* note 2, at A1 ("This question of costs is a defeat for industry, a serious setback . . . ." (quoting M. Reed Hopper of the Pacific Legal Foundation)); Glenn Hess, *US Congress Looks to Require Cost Factors in EPA Rules*, ICIS NEWS (Feb. 28, 2001, 11:39 PM), www.icis.com/Articles/2001/02/28/133364/us-congress-looks-to-require-cost-factors-in-epa-rules.html (describing the criticism of the U.S. Chamber of Commerce, which argued that "a strong economy pays the bills for a clean environment and must be part of the equation for environmental policy").

[4] W. Kip Viscusi, *Regulating the Regulators*, 63 U. CHI. L. REV. 1423, 1424 (1996); *accord* Adam Babich, *Too Much Science in Environmental Law*, 28 COLUM. J. ENVTL. L. 119, 146–54 (2003).

[5] Amy Sinden, *In Defense of Absolutes: Combating the Politics of Power in Environmental Law*, 90 IOWA L. REV. 1405, 1411 (2005); *see also* Mark Geistfeld, *Reconciling Cost-Benefit Analysis with the Principle that Safety Matters More than Money*, 76 N.Y.U. L. REV. 114, 143–44 (2001) (discussing the use of cost-benefit analysis in the context of tort actions).

of negative health consequences.[6] As a result, the complete elimination of health risks for these pollutants could be accomplished only by banning all emissions. Such stringent standards would lead to widespread social dislocation, and even strongly pro-environmental commentators regard them as undesirable.[7] But when costs cannot be considered, it is difficult to justify any stopping point other than zero. Lower concentrations of these pollutants would lead to fewer adverse health risks, and if the only cognizable goal is to protect public health, how can EPA justify a nonzero concentration?[8] Under the standard reading of *American Trucking*, EPA faces the choice either to impose crushing social costs—which would be politically reckless—or to

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[6] As discussed below, there are several reasons the stopping-point problem might arise. First, for some pollutants, it is known (or assumed) that no exposure level exists for which a population-level threshold for adverse health effects can be established. *Infra* text accompanying note 176. This approach is commonly taken with respect to carcinogens. *E.g.*, Indus. Union Dep't, AFL-CIO v. Am. Petroleum Inst., 448 U.S. 607, 613 (1980) (plurality opinion). Second, sensitivity and exposure to some pollutants varies across the population in such a way that even if there is a population-wide threshold (below which no statistically significant effect is observed), there may not be a concentration level at which every single individual experiences zero risk. *Infra* text accompanying notes 140–41. Third, for some pollutants, biological responses may occur at all exposure levels, but it might not be clear whether those responses are negative. *See infra* text accompanying notes 159–60 (discussing the implications of this uncertainty on EPA's use of a particular critical effect in setting the lead NAAQS). Fourth, the selection of point estimates for uncertain values imposes risk associated with scientific uncertainty on the population. *Infra* text accompanying notes 150–53. Fifth, while there may be a lowest-observed effect level for the pollutant, there may be no evidence as to whether there is a no observed effect level at positive concentrations. *Infra* text accompanying notes 286–93. Sixth, even if a biological threshold were established, background levels of the pollutant may exceed that threshold, implying that any additional contribution to exposure would result in negative health risks. *Infra* text accompanying note 190.

[7] *See* DOUGLAS A. KYSAR, REGULATING FROM NOWHERE 20 (2010) ("Risk-risk, health-health, and environment-environment tradeoffs may be in some sense inevitable, as the economist reminds us, but they are *regrettably* so." (emphasis in original)); MARK SAGOFF, PRICE, PRINCIPLE, AND THE ENVIRONMENT 6 (2004) ("If some pollution has to be permitted to keep the economy running, it should be tolerated as a necessary evil, not welcomed as a welfare-enhancing utilization of resources."); Mary Jane Angelo, *Embracing Uncertainty, Complexity, and Change: An Eco-Pragmatic Reinvention of a First-Generation Environmental Law*, 33 ECOLOGY L.Q. 105, 119 (2006) ("Of course, an attempt to eliminate all environmental risks at all costs would be absurd."); Sinden, *supra* note 5, at 1475 (arguing that "rights may be overridden" if "the cost to society of extending the right 'would be of a degree far beyond the cost paid to grant the original right'" (quoting RONALD DWORKIN, TAKING RIGHTS SERIOUSLY 200 (1977))).

[8] *See* Cary Coglianese & Gary E. Marchant, *Shifting Sands: The Limits of Science in Setting Risk Standards*, 152 U. PA. L. REV. 1255, 1286 (2004) ("Unlike with threshold pollutants, where a standard can be set at a level below the threshold to provide complete health protection, the only way to protect against the entire continuum of adverse health effects from a nonthreshold pollutant would be to set a standard at the level of zero."); Cass R. Sunstein, *Is the Clean Air Act Unconstitutional?*, 98 MICH. L. REV. 303, 376 (1999) ("The truth is that the facts might be able to show the degree of risk (at least within a range), but they cannot show whether any particular degree of safety is 'safe enough.'").

determine an acceptable nonzero level of risk without reference to any social goal other than health, which would be an incoherent task. The agency must thus engage in an inquiry that is either irrational or that divorces its stated justifications from its actual decision. The result is, most likely, an elaborate obfuscation of the true reasoning underlying the agency's decision, undermining core values of the administrative state.[9] Additionally, as we show below, the stopping-point problem manifests itself not only in the context of nonthreshold pollutants—where it has been previously recognized[10]—but also when the agency treats a pollutant as having a population exposure threshold.[11]

We refer to the second problem as the inadequacy paradox. It arises because, contrary to the conventional account,[12] the requirement that EPA set the NAAQS without considering costs has *not* led to more stringent environmental standards than those that would have resulted from the application of cost-benefit analysis. An examination of the regulatory impact analyses conducted for the most recent rulemakings to set NAAQS for the six pollutants regulated under the program shows that, in four of the cases, the standards set by EPA were *less* stringent than those that would have resulted from the application of cost-benefit analysis. Only one of the standards was more stringent.[13] (For the remaining standard, EPA did not do the analysis necessary to make this determination.) Thus, if EPA had selected standards that maximized social welfare, more stringent standards would have been adopted in eighty percent of the relevant cases. Ironically, by eliminating costs from EPA's calculation, *American Trucking* may have promoted environmental standards that imposed suboptimally low costs on industry and thereby are less protective of public health than is socially desirable from an economic perspective. The application of cost-benefit analysis, a methodology that remains

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9 *Infra* text accompanying notes 312–31.

10 *See, e.g.*, Thomas O. McGarity, *Substantive and Procedural Discretion in Administrative Resolution of Science Policy Questions: Regulating Carcinogens in EPA and OSHA*, 67 GEO. L. J. 729, 734–36 (1979) (stating that regulators have no choice but to "make a subjective, or policy-dominated decision" in the case of nonthreshold pollutants).

11 *Infra* text accompanying notes 295–98.

12 *Supra* text accompanying notes 4–5.

13 EPA prepares regulatory impact analyses for the NAAQS, even though they do not formally consider them during the rulemaking process. Throughout this Article, we assume that these analyses would not be substantially different in a counterfactual situation where they were used as the basis for the final rulemaking. *See infra* text accompanying notes 335–36 (explaining that regulatory impact analyses are not formally considered when setting the NAAQS).

suspect in many environmentalist circles,[14] would have resulted in cleaner air. The inadequacy paradox undermines the standard justifications for health-based standards, which hinge on such standards resulting in a relatively more stringent level of environmental protection than would be the case under cost-benefit analysis.[15]

We argue that health-based standards should never be less stringent than the standards determined by cost-benefit analysis, thereby solving the inadequacy paradox. The central justification for health-based standards is that the level of regulatory protection should not be compromised by cost considerations. The current status quo turns this argument on its head, producing health-based standards that are less stringent than those that would result had cost been properly considered. *American Trucking* should not be interpreted as standing in the way of using cost-benefit analysis as a regulatory floor. The case was litigated in a context in which all the parties and all the Justices believed—erroneously, as it turned out—that the consideration of costs would lead to less stringent standards. Thus, its holding should be limited to such cases. With respect to the opposite scenario, which turns out to be the prevalent one, *American Trucking*'s broad language should be regarded as mere dicta and subject to relitigation.[16]

This Article proceeds as follows. Part I describes the use of health-based standards in environmental law, reviews the primary defenses invoked in their favor, and discusses the effects of *American Trucking*. Part II addresses the stopping-point problem, analyzing how EPA set the existing NAAQS. Part III emphasizes that the stopping-point problem is not confined to nonthreshold pollutants; that Justice Breyer's reliance on health-wealth tradeoffs in his *American Trucking* concurrence does not provide a satisfactory solution to the stopping-point problem, though it purports to do so; that agencies likely end up considering costs surreptitiously; and that the resulting obstruction of reason giving has negative consequences for the transparency, accountability, and soundness of agency decisionmaking. Part IV discusses the inadequacy paradox, showing how, for all but one of the NAAQS, the application of cost-benefit analysis

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[14] *See* RICHARD L. REVESZ & MICHAEL A. LIVERMORE, RETAKING RATIONALITY: HOW COST-BENEFIT ANALYSIS CAN BETTER PROTECT THE ENVIRONMENT AND OUR HEALTH 9 (2008) (noting that the "liberal camp" is skeptical of cost-benefit analysis, which it generally views as "a technique that has historically been invoked to justify deregulation or less stringent regulation"); Michael A. Livermore & Richard L. Revesz, Retaking Rationality *Two Years Later*, 48 HOUS. L. REV. 1, 7 (2011) (noting that among some groups "cost-benefit analysis . . . [has] remained anathema").

[15] *See infra* text accompanying notes 47–51 (discussing two ways in which health-based standards are presumed to lead to stricter regulation).

[16] *Infra* Part VI.B.

would have led to more stringent standards. Part V explains that the paradox is likely to result from the failure of health-based standards to take into account the ancillary benefits of regulation, the behavioral phenomenon of uncertainty aversion—under which unknown consequences are overemphasized—and the role of interest groups. Part VI reconceptualizes health-based standards, arguing that they should never be less stringent than the standards that would result from the application of cost-benefit analysis and explaining how *American Trucking* can be reinterpreted to allow this outcome.

I
SETTING THE STAGE

This first Part sets the stage for the arguments in this Article, providing a typology of approaches to environmental standard setting, surveying the arguments in favor of health-based standards, reviewing some environmental and public health regimes that use health-based standards, and discussing the *American Trucking* case that established the NAAQS as the most important instance of a health-based standard in U.S. environmental law.

A. Approaches to Environmental Standard Setting

The major U.S. environmental statutes contain three principal approaches for determining the stringency of environmental protection: cost-benefit standards, feasibility standards, and health-based standards. Cost-benefit analysis, in its most general form, places both costs and benefits along a common metric and supports the standard that maximizes net benefits (the difference between benefits and costs).[17] As practiced in the United States over the past several decades, cost-benefit analysis is grounded on a welfare economic conception of social good and measures net benefits through preference satisfaction, determining the desirability of a policy based on values assigned by those who are benefited and burdened by that policy.[18] Uncertainty and risk are dealt with through a rational utility max-

[17] Michael A. Livermore, *Can Cost-Benefit Analysis of Environmental Policy Go Global?*, 19 N.Y.U. ENVTL. L.J. 146, 150 (2011); Thomas O. McGarity, *A Cost-Benefit State*, 50 ADMIN. L. REV. 7, 16 (1998) ("[C]ost-benefit analysis requires the analyst to reduce costs and benefits to a common metric to facilitate comparisons.").

[18] *See* Gregory Scott Crespi, *Incorporating Endogenous Preferences in Cost-Benefit Analysis*, 17 PENN ST. ENVTL. L. REV. 157, 161 (2009) ("All impacts of the policies under consideration are measured, to the extent feasible, by the affected persons' willingness to pay to obtain the resulting benefits, or to avoid the resulting burdens."); Lewis A. Kornhauser, *On Justifying Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1037, 1039 (2000) ("[I]ndividual well-being is understood as the satisfaction of subjective preferences; in practice these subjective values are inferred from market choices of individuals or are

imization framework based on expected outcomes, taking account of risk aversion when appropriate.[19]

The use of cost-benefit analysis is required, with varying degrees of specificity, in only a few environmental statutes, notably the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Safe Drinking Water Act.[20] More importantly, ever since 1981, when President Reagan promulgated Executive Order 12,291, there has been a requirement that agencies conduct cost-benefit analyses of their proposed rulemakings and submit those analyses to the Office of Information and Regulatory Affairs (OIRA) in the Executive Office of the President.[21] All "significant" regulations—ones with an economic effect of more than $100 million per year[22]—must be justified by reference to cost-benefit analysis[23] and reviewed by OIRA[24] "to the extent permitted by law."[25] As a result of more than three decades of a consistent approach by administrations of both political parties, cost-benefit analysis and OIRA review have become "defining feature[s] of administrative law in the United States."[26]

There is a lengthy and contentious literature on cost-benefit analysis and its normative desirability. Defenders of cost-benefit analysis include Professor Cass Sunstein,[27] who served as the OIRA Administrator under President Barack Obama, and Justice Stephen Breyer,[28]

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elicited through survey techniques."); Livermore, *supra* note 17, at 161–62 ("Individual preferences . . . form the foundation for the practice of cost-benefit analysis . . . .").

19 Kornhauser, *supra* note 18, at 1039–44; McGarity, *supra* note 17, at 12–16 (reviewing risk assessment in the context of cost-benefit analysis).

20 *See* CASS R. SUNSTEIN, THE COST-BENEFIT STATE: THE FUTURE OF REGULATORY PROTECTION 14–15 (2002) (discussing how the first two statutes prohibit "unreasonable" risk—defining "unreasonable" by reference to costs and benefits—and how the third explicitly requires cost-benefit analysis); *see also* Lisa Heinzerling, *Environment, Justice, and Transparency: One Year in, a Reinvigorated Environmental Protection Agency*, 19 N.Y.U. ENVTL. L.J. 1, 9 (2011) (describing the cost-benefit framework of the Safe Drinking Water Act).

21 Exec. Order No. 13,563, 76 Fed. Reg. 3821 (2011) (Obama administration); Exec. Order No. 12,866, 58 Fed. Reg. 51,735 (1993) (Clinton administration); Exec. Order No. 12,291, 46 Fed. Reg. 13,193 (1981) (Reagan administration).

22 Exec. Order No. 12,866, *supra* note 21, § 3(f). President Obama's Executive Order "reaffirms the principles, structures, and definitions governing contemporary regulatory review that were established in Executive Order 12,866." Exec. Order No. 13,563, *supra* note 21, § 1(b).

23 Exec. Order No. 12,866, *supra* note 21, § 1(b)(6).

24 *Id.* § 6(a)(3)(C).

25 *Id.* § 1(b).

26 Michael A. Livermore & Richard L. Revesz, *Regulatory Review, Capture, and Agency Inaction*, 101 GEO. L.J. 1337, 1339 (2013).

27 SUNSTEIN, *supra* note 20, at 20.

28 STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION 68–69 (1993).

who has argued that tools like cost-benefit analysis can rationalize the regulatory process. Critics include Professors Lisa Heinzerling[29] and Douglas Kysar,[30] who maintain that cost-benefit analysis is indeterminate, includes questionable moral assumptions, and divorces rulemaking from the democratic process.

Critics of cost-benefit analysis have themselves been frequently criticized for lacking a normatively attractive alternative.[31] Some attempts have been made to develop such an alternative in the abstract, though only at too high a level of generality to provide regulators with the needed guidance.[32] For example, Professor Mark Sagoff suggests agencies should regulate up to the "knee of the [cost] curve,"[33] which is "the point at which the cost of controlling the next incremental unit of pollution begins to increase rapidly," and returns to the environment rapidly diminish per dollar spent.[34] But the slope of a cost curve typically increases continuously as the stringency of regulation increases.[35] Determining what counts as the "knee of the curve" is therefore an inevitably arbitrary inquiry. And, ironically, these "knee of the curve" approaches themselves balance, in a poorly specified way, regulatory benefits and regulatory costs.

Supporters of this line of criticism of cost-benefit analysis often favor feasibility standards, the second major approach to setting environmental regulation. Professor David Dreisen, a strong advocate of feasibility standards, defines them as requiring "stringent regulation" subject to constraints on "physically impossible environmental improvements" and standards "so costly that they cause widespread

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[29] *See* FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING 8–11 (2004) ("[F]ormal cost-benefit analysis often hurts more than it helps: it muddies rather than clarifies fundamental clashes about values.").

[30] KYSAR, *supra* note 7, at 20 (2010) (arguing that cost-benefit analysis "offers the implicit and misleading message that our needs consist only of better data and more-rigorous techniques of valuation").

[31] *See* Jonathan S. Masur & Eric A. Posner, *Against Feasibility Analysis*, 77 U. CHI. L. REV. 657, 659–60 (2010) ("[C]ritics have never been very clear about what decision procedure they prefer to CBA.").

[32] *See* Sidney A. Shapiro & Christopher H. Schroeder, *Beyond Cost-Benefit Analysis: A Pragmatic Reorientation*, 32 HARV. ENVTL. L. REV. 433, 469–82 (2008) (suggesting a general "pragmatic alternative").

[33] MARK SAGOFF, PRICE, PRINCIPLE, AND THE ENVIRONMENT 25 (2004); *accord* Mark Sagoff, *Ethical and Economic Principles*, *in* LAW OF ENVIRONMENTAL PROTECTION 161, 209 (Sheldon M. Novick et al. eds., 2012).

[34] SAGOFF, *supra* note 33, at 25; *see* Sidney A. Shapiro & Thomas O. McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729, 743 n.7 (1991) (noting that the "knee-of-the-curve" analysis "may provide an attractive starting point" for determining how much to spend on risk-reduction).

[35] Shapiro & Schroeder, *supra* note 32, at 481.

plant shutdowns."[36] Dreisen defends feasibility standards as appropriately accounting for the concentrated costs associated with job losses from plant closure while giving no weight to "even large costs . . . if regulated parties will disperse those costs widely," as would be the case for a slight increase in the price of a widely used consumer good.[37] Best available technology standards in the Clean Air Act[38] and Clean Water Act[39] are prominent examples of feasibility standards.

Professors Eric Posner and Jonathan Masur offer a persuasive argument that feasibility standards are normatively undesirable.[40] Drawing on detailed case studies of the regulation of chromium by the Occupational Safety and Health Administration and of paper mills by EPA, they argue that if welfare maximization is taken as the goal of regulatory policy, feasibility standards "create[ ] significant problems of over- and underregulation."[41] Overregulation results "because feasibility analysis ignores the cost of regulations to consumers"[42] and underregulation because "feasibility analysis tolerates dangerous industrial practices"[43] in instances in which shutting down plants would be socially desirable. In these two ways, feasibility standards differ from, and are inferior to, cost-benefit standards.

Furthermore, Posner and Masur argue that alternative understandings of well-being, such as the capabilities approach put forward by Martha Nussbaum, do not map onto the priorities expressed by feasibility standards, and that "[n]o attempt to reverse-engineer a theory of well-being that justifies feasibility analysis has been successful."[44] On the basis of this analysis, they conclude that feasibility standards "lack[ ] a normative justification and should have no place in government regulation."[45]

Health-based standards, the subject of this Article, are the third principal approach to determining the stringency of environmental regulation. These standards seek either the entire elimination of a

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[36] David M. Driesen, *Distributing the Costs of Environmental, Health, and Safety Protection: The Feasibility Principle, Cost-Benefit Analysis, and Regulatory Reform*, 32 B.C. ENVTL. AFF. L. REV. 1, 9 (2005).

[37] David M. Driesen, *Two Cheers for Feasible Regulation: A Modest Response to Masur and Posner*, 35 HARV. ENVTL. L. REV. 313, 323 (2011).

[38] 42 U.S.C. § 7412(d)(2) (2012); *id.* § 7475(a)(4) (requiring facilities to use "best available control technology"); *id.* § 7479(3) (defining "best available control technology").

[39] 33 U.S.C. § 1311(b)(2)(A) (2012).

[40] Masur & Posner, *supra* note 31.

[41] *Id.* at 704.

[42] *Id.*

[43] *Id.*

[44] *Id*. at 709.

[45] *Id*. at 662.

public health risk or, failing that, the achievement of what is deemed to be an acceptable level of risk.[46] They thus differ from cost-benefit standards because they do not (explicitly) trade off health improvements against competing social priorities such as costs. They differ from feasibility standards because they are not constrained by what a particular industry could achieve without going out of business. The balance of this Article addresses the desirability of health-based standards as an alternative to cost-benefit analysis and focuses on the NAAQS—the most prominent example of health-based standards in U.S. environmental law.

B. Arguments for Health-Based Standards

There have been several attempts by academic commentators and protection-oriented interest groups to justify the use of health-based over cost-benefit standards. This section summarizes the four leading arguments made by supporters of health-based standards.

First, they argue that cost-benefit analysis tends to overemphasize costs and underemphasize health concerns.[47] Much of this criticism stems from the manner in which the costs and benefits are evaluated in practice. Some contend that while costs are relatively easy to quantify, health risks are "difficult to quantify, statistical, and remote."[48]

Second, they express the concern that cost-benefit analysis fails to address the power imbalance between regulated industries and the diffuse beneficiaries of environmental protection.[49] They believe that, in contrast, health-based standards can counteract this imbalance by elevating environmental protection above the considerations of cost.[50] For example, Professor Amy Sinden argues that "cost-blind" stan-

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[46] *See* David M. Driesen, *Should Congress Direct the EPA to Allow Serious Harms to Public Health to Continue?: Cost-Benefit Tests and NAAQS Under the Clean Air Act*, 11 TUL. ENVTL. L.J. 217, 220–21 (1998) (noting that in the context of setting the NAAQS, "we must either choose a zero level for pollutants or recognize some element of discretion in deciding what constitutes an adequate margin of safety").

[47] *See* John P. Dwyer, *The Pathology of Symbolic Legislation*, 17 ECOLOGY L.Q. 233, 248 (1990).

[48] *Id.*; *see also* Driesen, *supra* note 46, at 222–23 (noting the difficulty of quantifying environmental and public health problems).

[49] *Cf.* Sinden, *supra* note 5, at 1409; *see also* Dwyer, *supra* note 47, at 248 ("[I]ndustry generally has the best information about the costs and feasibility of pollution controls, and thus it is able to present data supporting predictions of dire economic consequences if strict standards are adopted.").

[50] *See* Sinden, *supra* note 5, at 1410–11 (advocating a "trumping approach" in environmental law by analogizing to constitutional rights jurisprudence, which is also concerned with combating disparities of power).

dards "place a thumb on the scale in favor" of environmental protection and serve a "crucially important power-shifting function."[51]

A third argument offered in support of health-based standards is that they can serve as a "technology-forcing" device.[52] According to this rationale, by directing the regulator to consider only health-related factors, industry may be forced to develop stronger control technologies.[53] Attainment of a standard that appears to be prohibitively expensive at the time legislation is adopted may become affordable as new control technologies and pollution prevention strategies are developed.[54] For example, the architects of the CAA believed that polluters would find effective ways to meet new requirements, even if the necessary technology did not exist at the time.[55]

Fourth, proponents of health-based standards also seek to justify them on nonwelfarist grounds.[56] Under these types of justifications, regulation is necessary even when "the aggregate cost outweighs the aggregate harm" because "[s]trong ethical considerations support the notion that we all have an obligation to avoid seriously harming our neighbors' health."[57] One version of this view is that human life and health, or a clean environment, should not be viewed as a commodity whose value can be compared with the economic costs of pollution

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[51] *See id.* at 1411.

[52] Dwyer, *supra* note 47, at 248.

[53] *See id.*; *see also* Driesen, *supra* note 46, at 234 ("Health-protective standards may help stimulate needed innovations, overcome failures to implement inexpensive and obvious measures, create jobs, and stimulate efficiency improvements, while greatly reducing the numerous harms dirty air causes."); Thomas O. McGarity, *Media-Quality, Technology, and Cost-Benefit Balancing Strategies for Health and Environmental Regulation*, 46 LAW & CONTEMP. PROBS. 159, 221 (1983) ("Congress might, for example, decide to 'force' technology by prescribing requirements that are capable of being met only through the implementation of newly evolving or nonexistent technologies.").

[54] Joseph M. Feller, *Non-Threshold Pollutants and Air Quality Standards*, 24 ENVTL. L. 821, 885 (1994).

[55] *See* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 490 (2001) (Breyer, J., concurring) ("[L]egislative history shows that Congress intended the statute to be 'technology forcing.'"); *see also* Union Elec. Co. v. EPA, 427 U.S. 246, 256–57 (1976) (stating that the 1970 Amendments to the CAA were "expressly designed to force regulated sources to develop pollution control devices that might at the time appear to be economically or technologically infeasible"); John E. Bonine, *The Evolution of "Technology-Forcing" in the Clean Air Act*, ENV'T REP. (BNA), MONOGRAPH NO. 21 (1975), *as reprinted in* JOHN E. BONINE & THOMAS O. MCGARITY, THE LAW OF ENVIRONMENTAL PROTECTION 280 (1984) (discussing the "technology-forcing" motivations of the Clean Air Act).

[56] For a discussion of the ethical criticisms of cost-benefit analysis in environmental regulation, see Steven Kelman, *Cost-Benefit Analysis and Environmental, Safety, and Health Regulation: Ethical and Philosophical Consideration*, *in* COST-BENEFIT ANALYSIS AND ENVIRONMENTAL REGULATIONS: POLITICS, ETHICS, AND METHODS 137 (Daniel Swartzman et al. eds., 1982).

[57] Driesen, *supra* note 46, at 223.

reduction.[58] Others have argued that a "'right' to a healthy environment" trumps other considerations.[59] Some supporters of health-based standards emphasize their symbolic benefits. Under this view, Congress adopts health-based environmental controls "because they establish government priorities and public values promoting protection of public health."[60]

C. Regulatory Programs Prohibiting the Consideration of Costs

While the NAAQS are the highest profile and most important example of health-based standards, they are not the only one. This section briefly describes some other examples. When many environmental, public health, and safety statutes were adopted, "formal economic cost-benefit analysis remained largely confined to academic circles, and . . . Congress and the courts remained highly skeptical of the idea."[61] Since that time, attitudes toward cost-benefit analysis have undergone a major shift, as exemplified by the emergence of OIRA review as a major component of the administrative state.[62] Statutes from an earlier era, however, remain on the books and prohibit the consideration of costs in determining the extent of protection to the environment or to health and safety.

For example, section 182(a) of the Atomic Energy Act requires that the Nuclear Regulatory Commission (NRC) make a finding that "the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public."[63] In *Union of Concerned Scientists v. U.S. Nuclear Regulatory Commission*, the D.C. Circuit held that "[i]n setting or enforcing the standard of 'adequate protection' that this section [182] requires, the Commission may not consider the economic costs of safety measures."[64]

The *UCS* court reasoned that "when Congress desired agencies to consider economic costs, it knew how to say so," citing the Flood Control Act of 1936 as an example.[65] Looking to the legislative history of the 1954 amendments, the court painted a picture of a Congress deeply concerned with the "grave threats" that nuclear power

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58 *See* Feller, *supra* note 54, at 881 (discussing core criticisms of cost-benefit analysis).

59 McGarity, *supra* note 53, at 161.

60 Dwyer, *supra* note 47, at 249.

61 Amy Sinden, *The Economics of Endangered Species: Why Less Is More in the Economic Analysis of Critical Habitat Designations*, 28 HARV. ENVTL. L. REV. 129, 136 (2004).

62 *See supra* text accompanying notes 21–26.

63 42 U.S.C. § 2232(a) (2012).

64 824 F.2d 108, 114 (D.C. Cir. 1987).

65 *Id.* at 114–15.

presented "to the very existence of civilization," and therefore construed the statute as implicitly prohibiting cost considerations.[66]

One of the most controversial prohibitions on cost consideration existed for many years in the context of food additives: the Delaney Clause of the Food, Drug, and Cosmetics Act.[67] Courts interpreted the clause to prevent the Food and Drug Administration (FDA) from approving any food additive "if it is found to induce cancer when ingested by man or animal,"[68] holding that costs could play no role in this determination.[69] When an absolute prohibition on the approval of such additives proved to be unworkable, the FDA attempted to create an exception to the prohibition, which would allow approval of additives that produced lifetime cancer risk of less than one in one million.[70] The D.C. Circuit, however, found this interpretation to be unacceptable, determining that even "trivial risks" were impermissible.[71]

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[66] *Id.* at 115. The *UCS* court held that the NRC *could* consider costs when "devising or administering requirements that offer protection beyond" those required by "adequate protection." *Id.* at 114; *see also* Pub. Citizen v. Nuclear Regulatory Comm'n, 573 F.3d 916, 918 (9th Cir. 2009) ("The Commission is authorized to impose additional safety measures on licensees above those required by adequate protection, and in doing so may consider the economic costs of those extra measures.").

[67] 21 U.S.C. § 348(c)(3)(A) (1994) (repealed 1996).

[68] *See* Bell v. Goddard, 366 F.2d 177, 181 (7th Cir. 1966) (quoting 21 U.S.C. § 348(c)(3)(A)).

[69] *See* Les v. Reilly, 968 F.2d 985, 989 (9th Cir. 1992) (holding that "Congress intended to ban all carcinogenic food additives, regardless of amount or significance of risk"); Frank B. Cross, *The Consequences of Consensus: Dangerous Compromises of the Food Quality Protection Act*, 75 WASH. U. L. Q. 1155, 1159 (1997) (noting that decisions under the Delaney Clause were taken "regardless of any cost-benefit balancing"); Richard A. Merrill, *FDA's Implementation of the Delaney Clause: Repudiation of Congressional Choice or Reasoned Adaptation to Scientific Progress?*, 5 YALE J. ON REG. 1, 1 (1988) (noting that food ingredients shown to cause cancer are prohibited "regardless of the benefits the ingredients might provide or the magnitude of the risk").

[70] Pub. Citizen v. Young, 831 F.2d 1108, 1111 (D.C. Cir. 1987).

[71] *Id.* at 1122. A similar pattern is present in the Endangered Species Act, an environmental program not involving the protection of public health. In *TVA v. Hill*, the Supreme Court enjoined the construction of the Tellico Dam because of its impact on the then-endangered snail darter, famously holding that the Endangered Species Act precluded cost consideration, at least in certain contexts. 437 U.S. 153, 184 (1978) ("The plain intent of Congress in enacting this statute was to halt and reverse the trend toward species extinction, whatever the cost."). The Court's holding was softened somewhat by a subsequent statutory amendment, which created an exemption process for government projects that jeopardize endangered or threatened species. *See* 16 U.S.C. § 1536(h)(1) (2012). *See generally* Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L. Q. 1029 (1997) (discussing decisionmaking under the Endangered Species Act).

The Delaney Clause had many detractors,[72] and in the years prior to its repeal the FDA consistently sought to reinterpret or ignore it in order to produce more palatable regulatory outcomes.[73] The statute was ultimately amended in 1996.[74]

Although important, none of these health-based standards have the salience of the NAAQS, which are the cornerstone of the United States' air pollution control efforts. We now turn to showing how the NAAQS came to be understood to bar the consideration of costs.

D. NAAQS and American Trucking

Under the Clean Air Act, EPA is directed to set both primary and secondary NAAQS based on a "criteria" document that analyzes the most current scientific information on the air pollutant.[75] The primary NAAQS must be set at the level "requisite to protect the public health" with an "adequate margin of safety."[76] The secondary NAAQS must be set at the level "requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air."[77] NAAQS are set uniformly across the entire country.[78]

The prohibition on the consideration of costs in the setting of the NAAQS is longstanding, dating back to the D.C. Circuit's 1980 decision in *Lead Industries Association v. EPA*.[79] The court reasoned there that if Congress had intended for EPA "to be concerned about

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[72] *See, e.g.*, Merrill, *supra* note 69, at 1 (calling the Delaney Clause an "extreme polic[y]" that was "increasingly difficult to administer").

[73] *See id.* at 2.

[74] Thomas O. McGarity, *Politics by Other Means: Law, Science, and Policy in EPA's Implementation of the Food Quality Protection Act*, 53 ADMIN. L. REV. 103, 116–17 (2001) (noting that consumer groups were able to extract concessions during the legislative process in the form of heightened protections for children).

[75] 42 U.S.C. §§ 7408(a)(2), 7409(a) (2012). *See infra* note 247 for the current form of the criteria document.

[76] *Id.* § 7409(b)(1).

[77] *Id.* § 7409(b)(2). "Welfare" is defined as including, *inter alia*, "effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants." *Id.* § 7602(h).

[78] In particular, the NAAQS do not take into account local population concentrations or the ease with which ambient concentrations can be achieved. *See* James E. Krier, *The Irrational National Air Quality Standards: Macro- and Micro-Mistakes*, 22 UCLA L. REV. 323, 323–25 (1974) (stating that NAAQS are uniform and describing a particularly costly application of that rule in Los Angeles). The State Implementation Plan process, by which states implement the NAAQS, may somewhat alleviate this problem. *See* Douglas R. Williams, *Cooperative Federalism and the Clean Air Act: A Defense of Minimum Federal Standards*, 20 ST. LOUIS U. PUB. L. REV. 67, 75 (2001) (discussing the SIP process).

[79] 647 F.2d 1130 (D.C. Cir. 1980).

economic and technological feasibility, it [would have] expressly so provided."[80] Further, the court relied on the statute's legislative history to conclude that the omission of any discussion of "economic and technological feasibility" was "a deliberate decision by Congress to subordinate such concerns to the achievement of health goals."[81]

In *Whitman v. American Trucking Associations*, the Supreme Court affirmed EPA's practice of not considering costs when setting NAAQS.[82] Justice Scalia, writing for the Court, noted that the language of section 109 was "absolute" and instructed EPA to use the information about health effects contained in the criteria documents to "identify the maximum airborne concentration of a pollutant that the public health can tolerate, decrease the concentration to provide an 'adequate' margin of safety, and set the standard at that level."[83] He added that "[n]owhere are the costs of achieving such a standard made part of that initial calculation."[84]

The plaintiffs in *American Trucking* unsuccessfully argued that cost could be considered under various phrases in the statute. They first claimed that costs were included in the definition of "public health," as the economic cost of implementing a too-stringent standard could produce health losses sufficient to offset the health gains achieved from decreased air pollution. The Court rejected this argument, finding that Congress was aware of this problem and had factored it into other provisions of the CAA that explicitly discussed compliance costs.[85] The Court similarly dismissed arguments that cost could be considered in the context of determining the "adequate margin [of safety]" or what is "requisite" to protect public health.[86] It "refused to find implicit in ambiguous sections of the CAA an authorization to consider costs that has elsewhere, and so often, been expressly granted."[87] The Court concluded that section 109(b), interpreted "in its statutory and historical context and with appreciation for its importance to the CAA as a whole, unambiguously bars cost considerations from the NAAQS-setting process."[88]

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[80] *Id.* at 1148.

[81] *Id.* at 1149.

[82] 531 U.S. 457 (2001).

[83] *Id.* at 465.

[84] *Id*. The Supreme Court also found that the NAAQS were not an unconstitutional delegation of legislative power, reversing the D.C. Circuit's holding that EPA's construction of the CAA effected an unconstitutional delegation of legislative power, because it was not guided by an intelligible principle. *Id.* at 475–76.

[85] *Id.* at 466–67.

[86] *Id.* at 468.

[87] *Id.* at 467.

[88] *Id.* at 471.

II
Stopping-Point Problem

This Part examines the decisionmaking process used by EPA when setting the NAAQS and argues that the agency faces choices at several points along the way that it cannot resolve on health considerations alone.

There are a host of judgments that the Administrator must make when setting the NAAQS. Scientific questions that the Administrator must confront include the ability (or inability) of central site monitors to accurately reflect regional pollution concentrations,[89] the exposure levels for which specific health effects occur,[90] and the role that individual behaviors may play in modifying exposures or risks.[91] In spite of limited information, the Administrator must exercise considerable judgment to provide best-estimate answers to empirical questions concerning the state of the world.

The current NAAQS process also requires the Administrator to confront questions that are not scientific in nature. These decisions require the agency to identify a stopping point for regulatory stringency given a set of state-of-the-world estimates (including uncertainty about those estimates). This second set of judgments includes deciding which negative health consequences will be deemed tolerable and what level of certainty concerning the link between exposure and health is sufficient to justify imposing controls. It also includes the determination of the percentage of the population to protect, which often translates into a question of how many people who are particularly susceptible to the negative consequences of the pollutant (for genetic reasons or otherwise[92]) to leave unprotected. To the extent that there are correct answers to such questions, they sound in morality or politics, not science.[93] Most important for purposes of this

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[89] *See infra* notes 212, 353 (noting the impact that monitoring site location can have on pollution statistics).

[90] *See, e.g.*, *infra* text accompanying notes 115–17 (describing how EPA established the relationship between environmental exposure and critical effect with respect to the lead standard).

[91] *See Ozone Action Days*, U.S. Envtl. Prot. Agency, http://www.epa.gov/region04/air/naaqs/ozoneday.htm (last updated Dec. 13, 2012) (suggesting behaviors to help reduce ozone formation). Our thanks to Kevin Cromar for his suggestions on this categorization.

[92] *See* Gary E. Marchant, *Genetic Susceptibilities: The Future Driver of Ambient Air Quality Standards?*, 43 Ariz. St. L.J. 791, 795–98 (2011) (emphasizing the importance of addressing genetic predispositions).

[93] *See* McGarity, *supra* note 10, at 734 ("Correct answers to [trans-scientific] questions may exist as a philosophical matter, but the 'truth' is ultimately unascertainable in either the scientific or the legal forum."). *Cf.* Ronald Dworkin, Justice for Hedgehogs 152–56 (2011) (distinguishing scientific and moral inquiries and offering an "interpretive" account of moral truth).

Article, this second type of question cannot be answered simply by weighing evidence to estimate the state of the physical world.[94]

As will be demonstrated in more detail below, health-based standards encourage the Administrator to conflate these two different types of inquiry under the rubric of "public health policy judgment[s]."[95] The general point concerning inquiries of this sort has been made before.[96] This Part moves the conversation forward through three basic contributions. First, it provides a fine-grained analysis of the Administrator's reasoning in several recent NAAQS and shows where agency decisionmaking tends to shade from empirical to normative matters. Second, it distinguishes among several distinct sources of the stopping-point problem. Finally, it shows how a population-level threshold assumption turns out not to be a solution, because the stopping-point problem can be generated at multiple points in the NAAQS process. Even where the agency treats a pollutant as having such a threshold, the stopping-point problem continues to be present.

We start with the hard case: an analysis of the NAAQS for lead established in 1978. This standard was the first for which EPA provided a detailed explanation of its decisionmaking process,[97] following the adoption of the "hard look" doctrine, which required courts to ensure that agency decisions are "based on a consideration of the rele-

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[94] Cost-benefit analysis can provide answers, at least in theory, to this second type of question because it embodies a claim that maximizing preference satisfaction is socially desirable. Of course, this claim must be defended on normative grounds. *See* MATTHEW D. ADLER & ERIC A. POSNER, NEW FOUNDATIONS OF COST-BENEFIT ANALYSIS 25–26 (2006) (providing welfarist justification for cost-benefit analysis).

[95] *Infra* text accompanying notes 169–76.

[96] *See, e.g.*, Eric Biber, *Which Science? Whose Science? How Scientific Disciplines Can Shape Environmental Law*, 79 U. CHI. L. REV. 471, 474 (2012) ("[A] diverse range of values and perspectives [are] already embedded in the scientific disciplines that are relevant for environmental law."); Eric Biber & Berry Brosi, *Officious Intermeddlers or Citizen Experts? Petitions and Public Production of Information in Environmental Law*, 58 UCLA L. REV. 321, 372 (2010) ("[T]here may be a wide range of other benefits from public participation besides technical expertise, including obtaining public acquiescence or support for administrative regulatory decisions."); Doremus, *supra* note 71, at 1056 (stating that "the assumption that conservation policy decisions can be made objectively on the basis of existing or reasonably attainable scientific knowledge" is wrong); Holly Doremus, *Science Plays Defense: Natural Resource Management in the Bush Administration*, 32 ECOLOGY L.Q. 249, 251–52 (2005) ("Complaints about 'political science' in natural resource management are by no means new.").

[97] EPA had previously set standards for five pollutants: particulate matter, sulfur dioxide, nitrogen dioxide, ozone, and carbon monoxide. *See* National Primary and Secondary Ambient Air Quality Standards, 36 Fed. Reg. 8186, 8187 (Apr. 30, 1971) (to be codified at 42 C.F.R. pt. 410) [hereinafter 1971 NAAQS]. Yet the 1978 lead standard is the first one for which a detailed explanation exists in the administrative record.

vant factors."[98] For the 1978 lead standard, the agency adopted a threshold assumption. Nevertheless, our case study of the lead standard shows how EPA engaged in a balancing process that cannot be done coherently without taking costs into consideration. Next, we turn to an analysis of the most recent NAAQS for each of the regulated pollutants and show that this pattern is universal.

A. Original Lead Standard

Lead is a heavy metal with a low melting point that is easy to mold and sculpt.[99] It can be combined with other metals to form alloys.[100] These features make lead particularly suitable for various purposes, including pipes; paints, pigments, and glazes; weights; ammunition; cable covers; and radiation shielding.[101] Lead, however, is also known to cause a wide range of adverse health effects, including neurocognitive damage.[102] "Lead is emitted into the atmosphere by vehicles burning leaded fuel and by certain industries," such as lead and copper smelters, and by manufacturers of products such as leaded gasoline and leaded storage batteries.[103] Lead enters the human body both through inhalation (by breathing air that contains lead) and through ingestion (for instance, by drinking leaded water or by eating small particles of leaded paint).[104]

EPA came to regulate lead in the ambient air following the 1976 decision of *NRDC v. Train*.[105] The agency had previously acknowledged that lead could endanger the public health when it promulgated a rule controlling lead levels in gasoline under section 211 of the

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[98] Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971); *see also* Ethyl Corp. v. EPA, 541 F.2d 1 (D.C. Cir. 1976) (emphasizing the importance of the Administrator's discussion and analysis of the evidence in arbitrary and capricious review), *cert. denied*, 426 U.S. 941 (1976); Greater Bos. Television Corp. v. FCC, 444 F.2d 841, 851 (D.C. Cir. 1970) (stating that, in exercising their function to assure that agencies give reasoned consideration to all the material facts and issues, courts must insist that agencies articulate their reasons for decisions with reasonable clarity); Harold Leventhal, *Environmental Decisionmaking and the Role of the Courts*, 122 U. PA. L. REV. 509 (1974) (discussing the role of the courts in the then-new regulatory context).

[99] WORLD HEALTH ORG., CHILDHOOD LEAD POISONING 15 (2010), *available at* http://www.who.int/ceh/publications/leadguidance.pdf.

[100] *Id.*

[101] *Id.*

[102] National Ambient Air Quality Standards for Lead, 73 Fed. Reg. 66,964, 66,975–76 (Nov. 12, 2008) (to be codified at 40 C.F.R. pts. 50–51, 53, 58) [hereinafter Lead 2008 Final Rule].

[103] Lead: Proposed National Ambient Air Quality Standard, 42 Fed. Reg. 63,076, 63,076, 63,082 (proposed Dec. 14, 1977) (to be codified at 40 C.F.R. pt. 50) [hereinafter Lead 1977 Proposed Rule].

[104] *Id.* at 63,076.

[105] 411 F. Supp. 864 (S.D.N.Y.), *aff'd*, 545 F.2d 320 (2d Cir. 1976).

CAA.[106] Despite the potential endangerment to public health, EPA had initially planned to control lead emissions only from automobiles.[107] The Natural Resources Defense Council (NRDC), however, challenged EPA's approach and sought to compel the agency to list lead as a criteria pollutant under section 108 of the CAA,[108] and subsequently to develop national ambient air standards under section 109.[109] The U.S. District Court for the Southern District of New York ruled in favor of NRDC, and the Second Circuit affirmed.[110]

In 1978, EPA set the NAAQS for lead, adopting a threshold-based approach that sought to establish "a safe level of total lead exposure."[111] To find the threshold, the agency engaged in a critical-population–critical-effect inquiry, designed to identify a level of concentration which would leave even the most sensitive individuals unharmed. The logic was that if the most sensitive population was protected, everyone else would be protected as well. Moreover, if this population was protected against the adverse effects occurring at the lowest concentration, it (and therefore everyone else) would also be protected from all other adverse effects. EPA's analysis contained three principal steps. The first identified a critical effect within a critical population, the second linked that effect with an ambient environmental concentration, and the third identified an averaging methodology for environmental monitoring.

For the lead standard, EPA chose young children—between the ages of one and five—as the critically sensitive population, both because adverse health effects occur in children at lower exposure levels than in adults and because children have a greater risk of exposure to lead in dust and soil.[112] Children were also considered potentially more sensitive due to other factors, including their (1) larger intake of lead per unit of body weight, (2) physiological stress, (3) incompletely developed metabolic defense mechanism, and (4)

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[106] Ethyl Corp. v. EPA, 541 F.2d 1, 7 (D.C. Cir. 1976) (en banc) (upholding an EPA regulation under section 211 of the CAA, finding that "leaded gasoline present[s] 'a significant risk of harm' to the public health").

[107] *See Train*, 411 F. Supp. at 869 (describing EPA's argument that further action was unnecessary because it already chose to regulate lead in gasoline).

[108] *Id.* at 866.

[109] *See id.* at 867 n.2 (noting that listing a pollutant under section 108 necessitates creation of a NAAQS under section 109).

[110] *Id.* at 871; NRDC v. Train, 545 F.2d 320 (2d Cir. 1976).

[111] Lead 1977 Proposed Rule, *supra* note 103, at 63,079. "The threshold for a particular health effect is considered to be the blood lead level at which the effect is first detected." *Id.* at 63,078; *see also id*. at 63,079 (referring to "the lowest value given in the Criteria Document as a threshold").

[112] *Id.* at 63,077–78.

greater sensitivity of developing systems.[113] Pregnant women, workers, and individuals with specific genetic conditions were considered as alternative subgroups, but were rejected either because they were determined to be no more sensitive or because insufficient data existed to establish their sensitivity.[114] EPA chose lead-induced elevation of erythrocyte protoporphyrin (EP) as the critical effect,[115] explaining that this was consistent with a precautionary approach to setting air standards because elevated EP was a potential proxy for more harmful effects.[116] EPA considered other options for critical health effects,[117] but rejected them.[118]

For the second step—establishing the relationship between environmental exposure and the critical effect—EPA first determined a lead level in blood above which the critical population would suffer from the critical effect. The agency initially considered using the lowest reported blood level for EP elevation, which was fifteen milligrams of lead per deciliter of blood (μg/dL),[119] but in the final rule, EPA settled on 30 μg/dL as the "maximum safe blood lead level."[120] EPA then decided that to provide an adequate margin of safety and protect special high-risk subgroups, the standard should keep 99.5% of the target population below 30 μg/dL.[121] Based on a lognormal population distribution,[122] EPA found that the necessary target mean population blood lead level to achieve this goal was 15 μg/dL.[123]

However, EPA needed to regulate lead in air, not lead in blood, so it was necessary for it to determine the ratio of lead in air to lead in blood. The studies in the criteria document ranged from 1:1.2 to

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113 *Id.* at 63,078.

114 *Id.*; *see also* National Primary and Secondary Ambient Air Quality Standards for Lead, 43 Fed. Reg. 46,246, 46,252 (Oct. 5, 1978) (to be codified at 40 C.F.R. pt. 50) [hereinafter Lead 1978 Final Rule] (noting that EPA considered other possibilities, but "conclude[d] that young children, aged 1 to 5, are the sensitive population").

115 Lead 1977 Proposed Rule, *supra* note 103, at 63,078.

116 *See id.* at 63,079 (arguing that the use of EP elevation in the critical effect "is compatible with the scientific uncertainty about the health consequences of prolonged low level lead exposure").

117 For example, it considered Aminolevulinic Acid Dehydratase (ALAD) inhibition. *Id.* at 63,078.

118 *Id.*; *see also* Lead 1978 Final Rule, *supra* note 114, at 46,252–53 (discussing ALAD inhibition but ultimately basing its decision on EP elevation).

119 Lead 1977 Proposed Rule, *supra* note 103, at 63,079.

120 Lead 1978 Final Rule, *supra* note 114, at 46,253. This decision was consistent with the Centers for Disease Control (CDC) guidelines at the time. *See id.* (noting that the CDC characterized blood lead levels above 30 μg/dL as "undue exposure").

121 *See id.* at 46,251 (responding to comments that agency's proposed standard "incorporat[ed] an excessive margin of safety").

122 *See id.* at 46,255 ("[T]he blood lead levels for individuals in a given population of children are log-normally distributed.").

123 *Id.* at 46,251.

1:2.3.[124] EPA selected a ratio of 1:2, meaning that an increase of one milligram of lead per cubic meter of air ($\mu g/m^3$) was assumed to increase the level of lead in blood by 2 μg/dL.[125]

The next complication was that lead in blood comes not only from exposure to lead in air, but also from exposure to nonair sources of lead (such as children ingesting paint chips).[126] So, to determine the maximum permissible concentration of lead in air, EPA subtracted the concentration attributable to nonair sources from the total permissible concentration.[127] Some of the studies that EPA examined attributed as little as 10.2 μg/dL to nonair sources, while others attributed as much as 14.4 μg/dL.[128] EPA selected 12 μg/dL as the nonair source contribution to use in the determination of the NAAQS.[129] Subtracting 12 μg/dL from 15 μg/dL left 3 μg/dL as the allowable airborne lead contribution in the blood.[130] This concentration was then divided by 2 (the air-to-blood ratio), arriving at 1.5 μg/m as the maximum permissible concentration of lead in air.[131]

In the final step, EPA determined the averaging period. This decision has several important consequences. First, because air quality monitoring devices generate some measurement error, a longer averaging period increases the accuracy of the estimates that are used to determine whether an area is in attainment. Second, a longer averaging period can obscure real variability in air quality, in addition to reducing statistical noise. Finally, shorter averaging periods have the effect of increasing the effective stringency of the standard, since "high" measurements will be less likely to be counterbalanced by "low" measurements.[132]

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124 Lead 1977 Proposed Rule, *supra* note 103. In the final rule, however, EPA noted that the ratio ranged between 1:1 to 1:2. Lead 1978 Final Rule, *supra* note 114, at 46,250, 46,254.

125 Lead 1978 Final Rule, *supra* note 114, at 46,250, 46,254; Lead 1977 Proposed Rule, *supra* note 103, at 63,079.

126 *See* Lead 1978 Final Rule, *supra* note 114, at 46,253–54 (discussing the issue of nonair sources of lead).

127 *See id.* at 46,253 (describing this approach).

128 *Id.* at 46,253–54.

129 *See id.* at 46,254 ("EPA is calculating the lead standard based on the attribution of 12 μg Pb/dL of the blood lead level in children to lead sources unaffected by the lead air quality standard.").

130 *Id.*; Lead 1977 Proposed Rule, *supra* note 103, at 63,081.

131 Lead 1978 Final Rule, *supra* note 114, at 46,252, 46,254; Lead 1977 Proposed Rule, *supra* note 103, at 63,081.

132 High measurements may be the result of measurement error at a monitoring station or the result of actual temporary increases in ambient concentrations of the pollutant. In either case, a shorter averaging period makes it more likely that an area will be deemed out of attainment (holding both actual air quality and the standard constant).

EPA selected an averaging period of a calendar quarter.[133] While in the proposed rule EPA had used a one-month averaging period,[134] this period was extended in the final rule,[135] decreasing the effective stringency of the standard.[136] Thus, EPA promulgated a final primary NAAQS of 1.5 μg/m^3 with a quarterly averaging period.[137]

B. Continuous Spectrum of Risk for Threshold Pollutants

Although the agency made the assumption that lead had a population threshold level, there were nevertheless several dimensions to the decision that involved a continuous spectrum of risk, creating the conditions necessary for the stopping-point problem to arise. At each of several decision points, a higher level of safety could have been achieved. If the reduction of risks from lead exposure was the only goal that the agency could legitimately take into consideration, then the only justifiable stopping point would have been the complete elimination of exposure. But zero exposure would have led to the closure of the lead smelter industry,[138] a result that EPA did not want. More generally, eliminating pollution across the board would be incompatible with our industrialized society.[139] The agency's final decision, therefore, could not be justified only on the grounds it was authorized to consider. As a result, the final standard lacks a coherent rationale.

Consider first the issue of population diversity in the definition of safe blood levels. To arrive at 15 μg/dL as the target mean population blood level, the agency first determined that 30 μg/dL represented the level at which the critical effect would manifest itself in the critical population. It then found that, for a given exposure, blood levels of lead vary across a population, and estimated the resulting distribution to be lognormal.[140] Based on that distribution, the agency could identify a population mean at a level such that 99.5% of the population

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133 Lead 1978 Final Rule, *supra* note 114, at 46,246, 46,255.

134 Lead 1977 Proposed Rule, *supra* note 103, at 63,076, 63,081.

135 Lead 1978 Final Rule, *supra* note 114, at 46,246, 46,255.

136 *See id.* at 46,250 (recognizing that the longer averaging period presents a "slightly greater possibility of elevated air lead levels"); *id.* at 46,256 ("[A] longer averaging period is theoretically less stringent than a shorter averaging period.").

137 *Id.* at 46,246, 46,254–55.

138 *Cf. id.* at 46,256 (explaining that the economic assessment "indicates that some primary and secondary lead smelters . . . may be severely strained economically in achieving emission reductions that may be required").

139 *Cf.* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 496 (2001) (Breyer, J., concurring in part and concurring in the judgment) (arguing that regulation need not lead to deindustrialization, as "[p]reindustrial society was not a very healthy society; hence a standard demanding the return of the Stone Age would not prove 'requisite to protect the public health'").

140 Lead 1978 Final Rule, *supra* note 114, at 46,255.

would fall below 30 μg/dL. The selection of 99.5%, however, represents a choice. The agency instead could have selected 99.9%, 90%, or any other number.

At the level selected by EPA, the vast majority of the population was protected, of course, but 0.5% of the population was subjected to lead blood levels at which negative health impacts were anticipated. At the time, there were approximately twenty million children in the United States under the age of five,[141] meaning that 0.5% of the population represented 100,000 children. Five million children lived in central urban areas, where the lead exposure was likely highest.[142] EPA found that in this "population of children in central urban areas where air lead was at the standard level," 20,605 children would end up with levels of lead in blood above 30 μg/dL.[143]

EPA could, of course, have protected some of those children by requiring a mean population exposure of less than 15 μg/dL. But, as a result of the shape of the distribution, for any mean level of exposure greater than zero, there would be a tail of the distribution above 30 μg/dL. Thus, where actual exposure varies across the population, the agency confronted a stopping-point problem concerning the percentage of the population to leave unprotected.

A second question for which population diversity was an issue was the lead blood level attributable to nonair lead sources. One of the studies cited by the agency found that the nonair contribution was as high as 14.4 μg/dL.[144] If EPA had selected that value, holding all other parameters constant, 0.6 μg/dL would have been the allowable increment from air sources. With a 1:2 air-to-blood ratio, the standard would be 0.3 $\mu g/m^3$, five times more stringent than the standard that was eventually adopted.

EPA explained that nonair contributions were higher in certain parts of the country.[145] But since the agency was constrained by the statute to set uniform nationwide standards,[146] the only way to protect children ages one through five in the parts of the country with higher nonair exposures would be to set a more stringent nationwide standard. EPA acknowledged that actual population blood lead levels may exceed the benchmark it selected, yet explained that if it "were to use

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141 *Id.* at 46,253.

142 *Id.*

143 *Id.* at 46,255.

144 *Id.* at 46,254.

145 *See id.* at 46,253 ("[I]t can be expected that the contribution to blood lead levels from nonair sources can very [sic] widely . . . .").

146 *See* Lead 1977 Proposed Rule, *supra* note 103, at 63,080 ("EPA does not believe . . . that it is given the latitude to set area specific air quality standards under Section 109 [of the CAA].").

a larger estimate of nonair contribution to blood lead, the result would be an exceptionally stringent standard, which would not address the principal source of lead exposure."[147] So, by virtue of this decision, EPA left children in certain parts of the country exposed to levels of lead in blood above 30 μg/dL, candidly acknowledging that due to the variations in nonair contributions in different locations, no ambient air standard "can be assured of being protective in all locations."[148]

EPA also confronted population diversity in its choice of critical population. For example, a more sensitive population would probably have consisted of even younger children (perhaps newborns) or children with an additional condition complicating their situation (such as infants suffering from iron deficiency or malnutrition diseases).[149] Each of these alternative populations could have served as a basis for setting the ambient lead standard. Because of diversity of sensitivities within the population, the agency had no choice but to either select the single most sensitive person, or arrive at a sub-population that cannot be justified on the basis of health protection alone.

A different source for the stopping-point problem arises from the agency's selection of point estimates for uncertain parameter values. The air-to-blood ratio is an example. EPA selected the ratio of 1:2, within the possible range of 1:1.2 to 1:2.3.[150] In this connection, the agency noted that the studies on which it had relied were conducted on adults and that "children are known to have greater net absorption and retention of lead than adults."[151] Therefore, the agency noted that it is "reasonable to assume that the air lead to blood lead relationship for this sensitive population . . . is equal to if not greater than for adults."[152] EPA indicated that "the ratios for children are in the upper end of the range and may even be slightly above it."[153] Nonetheless,

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147 Lead 1978 Final Rule, *supra* note 114, at 46,254.

148 Lead 1977 Proposed Rule, *supra* note 103, at 63,080.

149 Some comments noted that "within the general population of children there were subgroups with enhanced risk due to genetic factors, dietary deficiencies, or residence in urban areas." Lead 1978 Final Rule, *supra* note 114, at 46,252. EPA acknowledged "the higher risk status of such groups" but indicated that it did not "have information . . . for estimating a threshold for adverse effects separate from that of all young children." *Id.* EPA also expressed concern "about the possible health risk of lead exposure for pregnant women and their fetuses," but noted that there was "insufficient scientific information for EPA to either confirm or dismiss" these concerns. *Id.*

150 *See supra* notes 124–25 and accompanying text (discussing EPA's selection of the air-to-blood ratio).

151 Lead 1978 Final Rule, *supra* note 114, at 46,250. *See also id.* at 46,254.

152 *Id.*

153 *Id.*

without providing any further explanation, it ultimately picked a value within the range rather than at its upper end or beyond it.

Even if the 1:2 ratio was the most reasonable point estimate given the information available at the time, by referencing the possible range, EPA effectively acknowledged that there was a non-negligible probability that the ratio was higher than 1:2. If the range reported was a 90% confidence interval, for example, there was a 5% chance that the ratio was 1:2.3 or higher. If the agency had selected a ratio of 1:2.3, the standard would have been 1.3 $\mu g/m^3$ rather than 1.5 $\mu g/m^3$. And, if it had selected both a nonair contribution of 14.4 $\mu g/dL$ and a ratio of 1:2.3, the final standard would have been 0.26 $\mu g/m^3$ instead of 1.5 $\mu g/m^3$—a level six times more stringent than the standard EPA chose. By selecting the point estimates that it did, the agency accepted that a certain amount of residual risk arising from scientific uncertainty would be imposed on the population.

The choice of averaging period illustrates another decision for which health considerations alone do not provide sufficient guidance. As noted above, a longer averaging period is more tolerant of occasional spikes in pollution.[154] Consider, for example, a period of time in which the daily level is 15 $\mu g/m^3$ (ten times the ambient air standard chosen by EPA) for three days in a single month as a result of an extraordinary occurrence and the rest of the time the level is 0.5 $\mu g/m^3$. The average for the month with the spike would be 1.95 $\mu g/m^3$, and therefore would violate a standard with the one-month period contained in the proposed rule.[155] In contrast, under the three-month averaging period contained in the final rule,[156] the average level would be 0.98 $\mu g/m^3$ and the standard would be met.

By holding the concentration level constant while increasing the averaging period, the agency effectively weakened the standard. In explaining this decision, the agency noted that the longer averaging period would "lower control costs, reduce the probable number of sources which have to control, and decrease the likelihood of plant closures."[157] None of these factors are related to the protection of public health.[158]

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[154] *See supra* notes 132–36 and accompanying text.

[155] Lead 1977 Proposed Rule, *supra* note 103, at 63,076, 63,081.

[156] Lead 1978 Final Rule, *supra* note 114, at 46,246, 46,255.

[157] U.S. ENVTL. PROT. AGENCY, ECONOMIC IMPACT ASSESSMENT FOR THE NATIONAL AMBIENT AIR QUALITY STANDARD FOR LEAD AND THE ECONOMIC IMPLICATIONS OF A QUARTERLY MEAN AVERAGING TIME FOR THE LEAD NATIONAL AMBIENT AIR QUALITY STANDARD add. at 1 (1978) [hereinafter ECONOMIC IMPACT ASSESSMENT LEAD 1978].

[158] This issue surrounding averaging periods arises for all of the NAAQS discussed in this Article. The effective stringency of an air quality standard can be understood as arising from the ambient concentration level coupled with an averaging period. Holding the

Finally, the choice of the critical effect creates another source for the stopping-point problem because the agency must distinguish between nonharmful biological responses (which may occur at very low exposure levels) and adverse health effects. In setting the 1978 lead NAAQS, EPA considered Aminolevulinic Acid Dehydratase (ALAD) inhibition as an alternative critical effect,[159] noting that it "represents the lowest level effect of lead that has been detected."[160] Had EPA relied on this critical effect instead of on EP elevation, the resulting standard would have been more protective.

There are, then, at least three distinct inquiries in the decision-making process for the 1978 lead NAAQS that create a stopping-point problem. First, variation in exposure or sensitivity to risk across the population implies that, no matter what the average exposure or average dose-response relationship, there will be some residual risk for a portion of the population unless emissions are completely eliminated. Second, the selection of point estimates for scientifically uncertain values imposes risk on the population. Third, the agency must distinguish between adverse health effects and transient biological responses.

If the only relevant factor under consideration were the reduction of health risks from lead exposure, EPA would have selected a more stringent standard. Confronting these three sources of the stopping-point problem and resolving them in favor of nonzero risk required the agency to make judgments beyond merely estimating empirical reality: It had to deem a nonzero risk socially acceptable.

To decide that such a risk is acceptable, some countervailing factor must bear on the agency's decision. Health-based standards, on their own, do not provide a basis for making that determination. But what that additional factor was cannot be discerned from the administrative record. In Part II.F below, we suggest that, despite the statutory prohibition, EPA is likely to take costs into account when setting the standards.

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concentration level constant, effective stringency can be reduced (or increased) by increasing (or reducing) the averaging period. Holding the averaging period constant, stringency is reduced (or increased) by increasing (or reducing) the concentration level. From an economic perspective, the optimal stringency is achieved through a combined concentration level and averaging period that maximizes net benefits. Health-based considerations alone, however, cannot justify an averaging period because averaging always reduces stringency. For this reason, the stopping-point problem discussed throughout this section with regard to concentration level is replicated with respect to the averaging period.

159 Lead 1977 Proposed Rule, *supra* note 103, at 63,078.

160 *Id.*; *accord* Lead 1978 Final Rule, *supra* note 114, at 46,252.

C. Stopping-Point Problem in Recent NAAQS

In this section, we show that the most recent NAAQS for each of the pollutants suffer from the same stopping-point problem as the 1978 lead NAAQS. If anything, the stopping-point problem is even more obvious—indeed, the agency openly acknowledges this difficulty, recognizing that it is required to perform an inquiry that gives it inadequate criteria for a final decision.[161]

The 1978 lead standard established the basic framework for setting the NAAQS: identifying a critical-population–critical-effect, establishing a relationship between environmental exposure and critical effect, and identifying an averaging period. This framework has remained consistent for the past three decades across rulemaking for the different pollutants.

In the 2008 lead standard, as in 1978, EPA again selected children aged one through five as the sensitive population, but the critical effect was changed to impact of lead exposure on children's IQ.[162] For ozone, EPA noted that exposure is related to a variety of respiratory symptoms, including respiratory tract inflammation and lung function decrement, and that groups at higher risk from those effects include people with asthma or lung disease, children, and older adults.[163] For the nitrogen dioxide standard, the critical population for the standard setting was asthmatics and the critical effect was "NO_2-induced increase in airway responsiveness."[164] Similarly, in setting the sulfur dioxide standard, EPA focused on asthmatics and selected reduction in lung function with accompanying respiratory symptoms as the critical effect.[165] For particulate matter, EPA considered a wider range of effects—including cardiovascular and respiratory effects—and considered a variety of at-risk populations, including children, older adults,

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[161] *See infra* note 217 and accompanying text (noting that EPA ultimately framed its decisions in part as policy judgments); *see also infra* Part III.C–D (discussing the negative effects of EPA's inability to consider costs).

[162] *See* Lead 2008 Final Rule, *supra* note 102, at 66,970, 66,973, 67,002 & 67,004–05 (discussing blood lead levels for children aged one through five and using an IQ loss framework for the critical effect).

[163] *See* National Ambient Air Quality Standards for Ozone, 73 Fed. Reg. 16,436, 16,440, 16,449 (Mar. 27, 2008) (to be codified at 40 C.F.R. pts. 50, 58) [hereinafter Ozone 2008 Final Rule] (discussing scientific evidence of these effects).

[164] Primary National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474, 6500 (Feb. 9, 2010) (to be codified at 40 C.F.R. pts. 50, 58) [hereinafter Nitrogen Dioxide 2010 Final Rule].

[165] *See* Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,525–26, 35,536 (June 22, 2010) (to be codified at 40 C.F.R. pts. 50, 53, 58) [hereinafter Sulfur Dioxide 2010 Final Rule] (discussing clinical and epidemiological studies and noting the need to protect asthmatics).

and individuals with pre-existing heart and lung disease.[166] Finally, for carbon monoxide, EPA focused on decreased oxygen availability to critical tissues and organs, especially the heart, as the central adverse health effect associated with carbon monoxide exposure.[167] It considered individuals with cardiovascular disease to be the most susceptible to such effects.[168]

As discussed in the previous section, there are many potential sources for the stopping-point problem. Even in the 1978 lead NAAQS, in which the agency explicitly adopted a threshold assumption, the stopping-point problem continued to arise. In setting the 2008 lead standard, EPA recognized that with regard to IQ loss in children "there are currently no commonly accepted guidelines or criteria within the public health community that would provide a clear basis for reaching a judgment as to the appropriate degree of public health protection that should be afforded."[169] Regarding the selection of air-to-blood ratio in the 2008 lead standard, EPA admitted that the choice of what was appropriate within the range of evidence was a "public health policy judgment."[170] Similarly, in the sulfur dioxide final rule, EPA acknowledged that with regard to the level of exposure "there is no bright line clearly mandating the choice of level within the reasonable range proposed," but rather the "choice of what is appropriate within this reasonable range is a public health policy judgment."[171] Similar language is used in the final rules for nitrogen dioxide,[172] ozone,[173] carbon monoxide,[174] and particulate matter.[175]

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166 National Ambient Air Quality Standards for Particulate Matter, 78 Fed. Reg. 3086, 3088, 3130, 3154–55 (Jan. 15, 2013) (to be codified at 40 C.F.R. pts. 50–53, 58) [hereinafter Particulate Matter 2013 Final Rule].

167 Review of National Ambient Air Quality Standards for Carbon Monoxide, 76 Fed. Reg. 54,294, 54,298 (Aug. 31, 2011) (to be codified at 40 C.F.R. pts. 50, 53, 58) [hereinafter Carbon Monoxide 2011 Final Rule].

168 *Id*. at 54,299.

169 Lead 2008 Final Rule, *supra* note 102, at 66,997.

170 *Id.* at 66,998.

171 Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,546.

172 "There is no bright line clearly directing the choice of level. Rather, the choice of what is appropriate is a public health policy judgment." Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6500.

173 "[T]here is no evidence-based bright line that indicates a single appropriate level. Instead there is a combination of scientific evidence and other information that needs to be considered holistically in making this public health policy judgment and selecting a standard level from a range of reasonable values." Ozone 2008 Final Rule, *supra* note 163, at 16,476.

174 "[T]he final decision . . . is largely a public health policy judgment" that is "informed by the recognition that the available health effects evidence generally reflects a continuum." Carbon Monoxide 2011 Final Rule, *supra* note 167, at 54,308.

175 In the particulate matter final rule, EPA "recognizes that the long-term mean concentrations, or any other specific point in the air quality distribution of each study, do

What EPA calls a "policy judgment" includes not only judgments about physical states (such as the relationship between lead and IQ loss), but also judgments about how much risk is socially acceptable. Of course, if only public health considerations were relevant, less risk would always be better. And without considering the non-health consequences of a rule, such as the compliance costs, there can be no justification for any decision to allow any risk at all.

The following examples, drawn from the most recent NAAQS, show that the stopping-point problem continues to plague the agency's decisionmaking.

1. Lead

In 2008, EPA adopted an updated lead standard of 0.15 μg/m^3, a tenfold decrease from the 1978 standard. Once again, it chose children between the ages of one and five as the critical population. But this time, it used IQ loss as the critical effect.

The agency found that there was no threshold blood lead level below which the possibility of IQ loss could be excluded.[176] EPA initially proposed a population mean IQ loss of one to two points.[177] In the final rule, however, EPA chose an IQ loss of two points, reasoning that a specific level will be more useful than a range for purposes of clarity and given "the uncertainties in the health effects evidence and related information."[178] The agency acknowledged that there are no commonly accepted guidelines to provide a clear basis for a judgment as to the appropriate degree of public health protection, and that choosing between the options becomes merely a matter of agency discretion.[179]

EPA employed a linear dose-response relationship, and gave "greater weight" to the median slope from the four studies it examined, which was a 1.75 IQ point loss per μg/dL in blood.[180] As with the 1978 standard, the agency acknowledged that lead contami-

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not represent a 'bright line' at and above which effects have been observed and below which effects have not been observed." Particulate Matter 2013 Final Rule, *supra* note 166, at 3158.

176 *See* Lead 2008 Final Rule, *supra* note 102, at 66,975 ("Threshold . . . blood Pb levels . . . for neurological effects cannot be discerned from the currently available studies.").

177 *Id.* at 66,998.

178 *Id.* at 67,005.

179 *Id*.

180 *Id.* at 67,002–04.

nation is also caused by nonair sources, and that these dose-response curves focused solely on air-related lead exposure.[181]

EPA also updated the air-to-blood ratio from 1:2 to 1:7 based on recent scientific research.[182] On the basis of these changes in its analysis of the adverse health consequences of lead, the agency selected the 0.15 $\mu g/m^3$ standard.[183]

The lack of a basis for EPA's decision is even clearer in the 2008 lead standard than in its 1978 predecessor because the agency found that there was no threshold level of lead exposure below which IQ loss would be avoided. Why stop at two points and not at one or at three? Each of these alternatives would have adverse consequences. EPA acknowledged that there is no "evidence- or risk-based bright line that indicates a single appropriate level," but rather the decision is a "public health policy judgment."[184] Economic analysis could help here because it allows an inquiry into the value of that IQ loss and the value of what must be given up to avoid it. But absent this type of balancing inquiry, the agency has no choice but to arrive at an arbitrary number.

2. Ozone

Ozone exists both in the stratosphere, where it protects the earth from ultraviolet radiation, and in the troposphere, where it causes adverse health effects.[185] Nitrogen oxides and volatile organic compounds emitted from mobile and stationary sources react to produce ground-level ozone; the amount produced depends on temperature, solar radiation, wind speed, and other meteorological conditions.[186] Ozone exposure is related to a variety of respiratory symptoms, including respiratory tract inflammation and decreased lung function.[187] Epidemiological evidence links ozone exposure to emergency room visits and hospital admissions for respiratory and cardiovascular diseases, to school absenteeism, and to premature mortality.[188] Groups at higher risk from these effects include people with asthma or

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[181] *See id.* at 66,971 ("[H]uman exposures to Pb include nonair or background contributions in addition to air-related pathways."). In evaluating the risk of exposure, EPA separated the portion attributable to air-related exposure and nonair contributions. *See id*. at 66,982–83 tbl.2 (summarizing risk attributable to air-related Pb exposure for a range of alternative standards).

[182] *Id.* at 67,001, 67,004.

[183] *Id.* at 67,005–06.

[184] *Id.* at 67,006.

[185] Ozone 2008 Final Rule, *supra* note 163, at 16,437.

[186] *Id*.

[187] *Id*. at 16,440.

[188] *Id*.

lung disease, children, and older adults.[189] Controlling ozone presents special difficulties because exposure at or near background levels may be associated with adverse health effects, meaning that any additional contribution from human sources automatically creates risk.[190] Even if a theoretical threshold existed, ozone would be a nonthreshold pollutant as a practical matter as long as background levels exceeded that level.

EPA first promulgated NAAQS for ozone in 1971, setting a one-hour standard of 0.08 ppm,[191] and then revised the standard to 0.12 ppm in 1979.[192] In 1997, it replaced this standard with an eight-hour standard of 0.08 ppm,[193] and further revised this level to 0.075 ppm in 2008.[194]

In reaching this decision, EPA considered a range between 0.075 ppm and 0.070 ppm based on the available research and recommendations of the Clean Air Scientific Advisory Committee (CASAC).[195] EPA acknowledged that the evidence "does not provide a clear enough basis for choosing a specific level within the range" and that selecting a level is "clearly a public health policy judgment."[196] The more stringent alternative of 0.070 ppm would expose fewer asthmatic children to ozone levels at which they suffer adverse effects. But EPA found that the difference between the two is not an "appreciable difference[ ] from a public health perspective."[197] However, "differences," even if not "appreciable" ones, would counsel in favor of the more stringent standard unless there were competing considerations providing a stopping point. This point is underscored by the fact that the CASAC, an independent committee of distinguished academics

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189 *Id.* at 16,449.

190 Although EPA explained that "alternative assumptions about background levels had a variable impact depending on the health effect considered and the location," *id*. at 16,443, it noted that if a population threshold level does exist, it would likely be "well below" the level of the previous standard and "possibly within the range of background levels," *id*. at 16,444. *See also id*. at 16,465–66 (discussing methods of setting the policy-relevant background (PRB)).

191 1971 NAAQS, *supra* note 97, at 8186.

192 National Primary and Secondary Ambient Air Quality Standards: Revisions to the National Ambient Air Quality Standards for Photochemical Oxidants, 44 Fed. Reg. 8202, 8202 (Feb. 8, 1979) (to be codified at 40 C.F.R. pt. 50).

193 National Ambient Air Quality Standards for Ozone, 62 Fed. Reg. 38,856, 38,856 (Jul. 18, 1997) (to be codified at 40 C.F.R. pt. 50).

194 Ozone 2008 Final Rule, *supra* note 163, at 16,436. For a history of the various amendments, see *Ozone (O_3) Standards–Table of Historical Ozone NAAQS*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_history.html (last updated June 11, 2013).

195 Ozone 2008 Final Rule, *supra* note 163, at 16,475.

196 *Id*. at 16,482–83.

197 *Id*. at 16,481.

established under the CAA to provide scientific advice to EPA on the NAAQS, supported a level of 0.060 ppm.[198] In opting instead for a less stringent standard of 0.075 ppm, EPA went against the recommendation of its own scientific advisory committee.[199] Since EPA did not dispute the underlying scientific facts, the decision is hard to understand unless there were competing considerations.

This problem is also illustrated with respect to the standard's complicated averaging protocol.[200] EPA averages the data collected from monitoring stations over an eight-hour period, then the fourth-highest daily concentration in a year is determined, and finally, this concentration is averaged over a three-year period.[201] Compliance with the standard is determined by reference to this concentration.[202] Why does EPA base the standard on the average of the four days with

198 *See id.* at 16,483 (noting that while CASAC recommended 0.060 ppm, they were not opposed to a higher level). The 2008 rulemaking was challenged by several states, and by environmental and public health groups, which argued that the standard was not protective enough and specifically that EPA failed to explain its rejection of CASAC's recommendation. Mississippi v. EPA, 723 F.3d 246, 254, 260 (D.C. Cir. 2013). The same rule was also challenged by industry groups as well as several states, claiming it was too protective. *Id.* at 254. In 2008, after the election of President Obama, the D.C. Circuit granted EPA's unopposed motion to hold these cases in abeyance "to allow the agency to review the 2008 revisions and determine whether they should be reconsidered." *Id.* at 253. After a great deal of analysis, EPA issued a proposed regulation that would have tightened the standard to between 0.060 and 0.070 ppm. National Ambient Air Quality Standards for Ozone, 75 Fed. Reg. 2938, 2938 (proposed Jan. 19, 2010) (to be codified at 40 C.F.R. pts. 50, 58). OIRA, however, returned the rule to EPA. Letter from Cass R. Sunstein, Adm'r of Office of Info. and Regulatory Affairs, to Lisa Jackson, Adm'r of Envtl. Prot. Agency (Sept. 2, 2011), *available at* http://www.whitehouse.gov/sites/default/files/ozone_national_ambient_air_quality_standards_letter.pdf. In September 2011, EPA withdrew the reconsideration proceedings and indicated that it would complete the reconsideration during the next periodic review. Mississippi v. EPA, 723 F.3d at 253. The case challenging the 2008 rule thus returned to the D.C. Circuit, which recently upheld the primary ozone standard of 0.075 ppm, although it remanded EPA's decision to set the secondary NAAQS, for public welfare, at the same 0.075 ppm level. *See id.* at 270, 274 (denying petitions to change the standard). The court held that EPA was reasonable in departing from CASAC's recommendations and that it had satisfied its obligation to explain its reasons for departing from CASAC's advice by invoking "scientific uncertainty and more general public health policy considerations." *Id*. at 270.

199 EPA observed that the basis for CASAC's recommended range of standard levels appeared to be a combination of scientific and policy considerations. Ozone 2008 Final Rule, *supra* note 163, at 16,482. EPA reached a different policy judgment "based on apparently placing different weight" on two factors. *Id.* at 16,483. The first such factor was the role of the evidence from a set of specific studies (the Adams studies), for which EPA found the evidence reporting effects at 0.060 too limited. *See id.* at 83. The second factor was the risk assessment; EPA did not agree with CASAC that the risk assessment was an appropriate basis for concluding that levels at or below 0.070 ppm were required. *Id*.

200 *See supra* note 158 (detailing the importance of an averaging protocol that is well balanced with adequate maximum concentration levels).

201 Ozone 2008 Final Rule, *supra* note 163, at 16,474.

202 *Id.* at 16,474–75.

the highest concentration in the year rather than rely on the single day with the highest concentration, which would effectively lead to a more stringent standard? Similarly, why does it perform the three-year averaging, thereby weakening the standard, instead of simply relying on the yearly average? There is no obvious health basis for these choices. They appear to simply be pragmatic judgments about the optimal stringency of the standard. Such judgments would make sense if the protection of public health were weighed against other social objectives. But if health concerns are the only cognizable ones, they do not.

3. Nitrogen Dioxide

The main health effects of nitrogen dioxide exposure are respiratory symptoms.[203] The pollutant, which is used as an indicator for the existence of nitrogen oxides generally,[204] has been linked to emergency room visits and hospital admissions as well as cardiopulmonary-related mortality.[205] Children, older adults, and people with asthma and other respiratory diseases are most susceptible to these effects.[206] Nitrogen oxides are also known to be precursor gases that mix in the atmosphere with other pollutants to form particulate matter, which has a wide range of negative health effects.[207]

Nitrogen dioxide is emitted primarily by vehicles, with 60% of all emissions coming from on-road and off-road mobile sources.[208] Concentrations near roadways are estimated to be substantially higher than concentrations elsewhere, and, for most individuals, traffic is the main source of exposure.[209]

EPA first promulgated NAAQS for nitrogen dioxide in 1971, setting a standard of fifty-three parts per billion (ppb), using an annual mean.[210] Its 2010 review maintained the 1971 annual standard, but also added an additional hourly standard because health studies had reported respiratory effects following short-term exposures to

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[203] *See* Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6480 (describing airway hyper responsiveness, airway inflammation, and abnormal lung function among some of the effects of exposure).

[204] *Id.* at 6474.

[205] *Id.* at 6480.

[206] *Id.*

[207] Cliff I. Davidson et al., *Airborne Particulate Matter and Human Health: A Review*, 39 AEROSOL SCI. & TECH. 737, 737–40 (2005).

[208] Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6479.

[209] *See id*. (noting that nitrogen dioxide concentrations on and near highways could be approximately 80% higher on average than concentrations in areas away from highways).

[210] Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6476; 1971 NAAQS, *supra* note 97, at 8187, 8201.

nitrogen dioxide.[211] The agency also revised the locations of monitoring devices to reflect the increase in levels near roadways.[212]

As for the level of the standard, EPA considered setting the level at maximum area concentrations between 80 and 100 ppb, based on the epidemiological and controlled human exposure studies.[213] At and above 100 ppb, according to the controlled human exposure studies, increased airway responsiveness—the adverse health effect—was seen in "a large percentage of asthmatics."[214] But because NO_2 is a nonthreshold pollutant, as EPA indicates, there will be harm at lower concentrations as well.[215] In particular, EPA acknowledges that people with more severe asthma would be expected to show symptoms at lower concentrations than those prescribed by the standard.[216] Therefore, some proportion of the population will be subjected to the adverse effects that the standards are designed to avoid in most of the population. Thus, the question is, how can EPA decide how many people to leave unprotected without taking into account the nonhealth consequences of more stringent standards? Any answer that EPA might seek to give to this question would be incoherent; absent competing considerations, protecting more people would be better. So, as in the case of the other standards, EPA invokes the need to make "a public health policy judgment."[217]

The stopping-point problem is also apparent from the form of the nitrogen dioxide standard.[218] Compliance with the standard is based on "the 3-year average of the 98th percentile of the yearly distribution of 1-hour daily maximum concentrations."[219] Why did EPA use a

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211 Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6492, 6502. For a history of the various amendments, see *id*. at 6476–77; *Nitrogen Dioxide (NO_2) Standards – Table of Historical NO_2 NAAQS*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ttn/naaqs/standards/nox/s_nox_history.html (last updated June 11, 2013).

212 *See* Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6474, 6495 (commenting on the inaccuracy of only keeping previous monitor locations). The location of the monitoring sites, like the averaging period, *see supra* notes 132–36 and accompanying text, affects the effective stringency of the standard. In the case of the nitrogen dioxide NAAQS, the agency's choice of roadway monitoring increased the stringency of the standard.

213 Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6493.

214 *Id*. at 6500.

215 *See id*. (noting that the studies do not provide "any evidence of a threshold below which effects do not occur").

216 *See id*. (explaining that the meta-analysis evaluated primarily "mild asthmatics"). EPA does not specify in this context exactly how many asthmatics it believes will experience the effects associated with NO_2 exposure, stating only that "some" will. *Id*. at 6500–01.

217 *Id*. at 6500.

218 *See supra* Part II.C.2 (discussing the difficulty of choosing a stopping point due to the inconclusiveness of evidence).

219 Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6475.

three-year average here rather than demanding annual compliance? Why did it base the yearly average on the 98th percentile of daily concentrations, which is roughly the equivalent of the average of the seven days with the highest concentration, rather than the fourth day, as it had for ozone,[220] which would have led to protecting a larger proportion of the population? EPA candidly admits that "there is not a clear health basis for selecting one specific form over another."[221]

4. Sulfur Dioxide

The adverse health effects associated with sulfur dioxide exposure are respiratory and can be caused even by very short-term exposure.[222] Sulfur dioxide emissions originate primarily from point sources: fossil-fuel combustion at electric utilities and other industrial facilities account for 95% of U.S. emissions.[223]

The ambient air quality standard is designed to protect against exposure to a range of sulfur oxides, and sulfur dioxide is used as an indicator for the existence of the full range of sulfur oxides.[224] Sulfur oxides, like nitrogen oxides, are also precursor gases to the formation of particulate matter.[225] EPA first promulgated the NAAQS for sulfur dioxide in 1971, setting a daily standard of 0.14 parts per million (ppm), not to be exceeded more than once per year, and an annual standard of 0.03 ppm.[226] In 2010, EPA revoked the annual and daily standards and established a new standard of 75 ppb with a one-hour averaging period, based on the three-year average of the annual 99th percentile of one-hour daily maximum concentrations.[227]

The agency focused on the population of individuals with asthma,[228] and the relevant adverse health effects were a reduction in lung function and increased susceptibility to respiratory risks if

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220 *See supra* text accompanying notes 200–02.

221 Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6493.

222 *See* Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,525 (noting that there is a strong causal relationship between respiratory morbidity and short-term exposures as low as five minutes).

223 *Id.* at 35,524.

224 *See id*. at 35,536 (noting that "emissions that lead to the formation of SO_2 generally also lead to the formation of other Sox oxidation products").

225 *Id*. at 35,588.

226 1971 NAAQS, *supra* note 97, at 8187.

227 Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,520, 35,541. For a history of the various amendments, see *id*. at 35,522–23; *Sulfur Dioxide (SO_2) Primary Standards – Table of Historical SO_2 NAAQS*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ttn/naaqs/standards/so2/s_so2_history.html (last updated June 11, 2013).

228 *See* Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,525, 35,536 (discussing health effects of sulfur dioxide exposure on primarily asthmatic individuals).

affected by a viral infection or other respiratory agent.[229] The primary concern regarding sulfur dioxide is short-term exposure. Studies showed adverse health effects from as little as five-minute elevated sulfur dioxide exposure, even at low concentrations.[230] Given the existing evidence, EPA believed an "appropriate averaging time" should range from five minutes to twenty-four hours.[231]

The agency eventually decided that a five-minute averaging time would be undesirable because it would result in "significant and unnecessary instability," as "locations would frequently shift in and out of attainment."[232] The agency agreed that this instability would reduce public health protection by interfering with the area's implementation plans and control programs.[233] This claim is somewhat implausible, because the central premise of the CAA is that areas should come into attainment with NAAQS set by reference to public health, not that the public health determination should be adjusted to avoid putting areas into nonattainment.

On the other hand, EPA also rejected longer averaging times (between three and eight hours) noting that "there is very little basis in the health evidence" to warrant such averaging times.[234] EPA selected a one-hour averaging time, which is "reasonably justified by the scientific evidence," could provide "adequate protection" against adverse health effects,[235] and may "substantially reduce" dangerous five- to ten-minute peak sulfur dioxide exposures.[236]

The scientific evidence suggested the adverse respiratory effects were found at exposure concentrations of 200 and 400 ppb, with exposure times of five minutes. EPA therefore examined what one-hour standard would be likely to limit five-minute exposures to these levels.[237] The agency began by considering standards in the range of 50 to 100 ppb.[238] It found that a one-hour level of 100 ppb (the less stringent end of the proposed range) would "appreciably limit" five-minute exposures to concentrations of 200 and 400 ppb,[239] protecting 97% and over 99% of asthmatic children from experiencing at least

229 *Id*. at 35,526.

230 *See id*. at 35,535 (noting that adverse health effects were found in areas with sulfur dioxide levels "lower than those allowed by the current annual standard").

231 *Id*. at 35,538–39.

232 *Id*. at 35,537, 35,539.

233 *Id.* at 35,537.

234 *Id*. at 35,538.

235 *Id*.

236 *Id*. at 35,537.

237 *See id.* at 35,541.

238 *See id.*

239 *Id*. at 35,541.

one five-minute exposure to over 200 and 400 ppb, respectively.[240] The agency noted that such a standard would allow at most two days per year where the average five-minute daily maximum exposures exceeded 400 ppb, and at most thirteen days per year where they exceeded 200 ppb.[241]

By comparison, at the stringent end of the proposed range, a standard of 50 ppb would protect over 99% of asthmatic children from experiencing one five-minute exposure both over 200 and 400 ppb.[242] EPA acknowledged that a 50 ppb level would be more effective in limiting the exposure to a level of 200 ppb, but noted the effects of exposure to 200 ppb are "appreciably less severe" than effects from exposure to 400 ppb.[243]

EPA placed "substantial weight" on a cluster of three epidemiologic urban studies, which showed statistically significant adverse effects from levels between 78 and 150 ppb.[244] The agency concluded that the standard should be set at 75 ppb,[245] noting that a one-hour standard at a level of 75 ppb is expected "to substantially limit" the exposure of asthmatics to five- to ten-minute concentrations of over 200 ppb.[246]

The stopping-point problem is, again, clearly illustrated here. As with lead, ozone, and nitrogen dioxide, in the absence of a threshold,[247] EPA had to choose a standard within a continuous range of risk. Within the range of 50 to 100 ppb, the more stringent the level, the greater the percentage of asthmatic children that would be protected. Other things being equal, of course, protecting more children

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240 *See id.* at 35,541–42.

241 *See id.* at 35,546.

242 *See id.* at 35,542.

243 *Id*. at 35,547.

244 *Id*.

245 *See id.* at 35,548.

246 *Id*.

247 The Integrated Science Assessment (ISA) for Sulfur Oxides found that "[t]he overall limited evidence from epidemiologic studies examining the concentration-response function of SO_2 health effects is inconclusive regarding the presence of an effect threshold at current ambient levels." U.S. ENVTL. PROT. AGENCY, EPA/600/R-08/047F, INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES – HEALTH CRITERIA 4–7 (2008). The ISA forms the scientific foundation for the NAAQS and includes assessments previously contained in the Air Quality Criteria Documents (AQCD). *See Air Quality: EPA's Integrated Science Assessments (ISAs) – Basic Information*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ncea/isa/basicinfo.htm (last updated Nov. 22, 2013) (providing an overview of Integrated Science Assessments). The agency did not incorporate a threshold into its regulatory impact analysis of the rule. *See* OFFICE OF AIR QUALITY PLANNING & STANDARDS, U.S. ENVTL. PROT. AGENCY, FINAL REGULATORY IMPACT ANALYSIS (RIA) FOR THE SO_2 NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) 5–10 (2010) (describing the rationale for not including thresholds in the analysis).

would be better. But EPA drew the line in the middle of the range, not at its lower bound. It acknowledged that because "there is no bright line clearly mandating the choice of level within the reasonable range proposed," determining how many asthmatic children should be protected is "a public health policy judgment."[248] But absent consideration of the negative consequences of more stringent standards, such as increased compliance costs, there is no coherent basis for making this judgment. All the agency has done is determine what proportion of the population will remain unprotected, without explaining why.

As with the nitrogen dioxide standard, the problem is also apparent in selecting the averaging times and mechanism:[249] Here, choosing a shorter averaging interval (such as five minutes instead of one hour) could have protected more asthmatic children from harmful exposure to sulfur dioxide. Similarly, EPA could have provided protection to a greater proportion of the population by basing its standard on the day of the year with the highest concentration, not on the average of the highest 1% of the days, nor on the average of the highest days over a three-year period.

5. Carbon Monoxide

The most serious adverse health effect associated with carbon monoxide exposure is decreased oxygen availability to critical tissues and organs, especially the heart, as inhaled carbon monoxide binds with hemoglobin in the blood to form carboxyhemoglobin (COHb).[250] Accordingly, EPA considers individuals with cardiovascular disease to be most susceptible to adverse health effects induced by carbon monoxide.[251] Mobile sources are a substantial contributor to carbon dioxide emissions, and the highest concentrations are typically in urban areas or near roadways.[252]

EPA first promulgated a NAAQS for carbon monoxide in 1971, setting a standard of 35 ppm with a one-hour averaging period and 9 ppm with an eight-hour averaging period, both not to be exceeded more than once per year.[253] As required by the CAA, EPA subsequently reviewed these standards several times, but did not amend them.[254]

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248 Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,546.

249 *See supra* note 158 (discussing problems arising from choice of averaging periods).

250 *See* Carbon Monoxide 2011 Final Rule, *supra* note 167, at 54,298.

251 *See id*. at 54,299.

252 *See id*. at 54,298.

253 *See* 1971 NAAQS, *supra* note 97, at 8187 (setting out the national standards for carbon monoxide).

254 Review of the National Ambient Air Quality Standards for Carbon Monoxide, 50 Fed. Reg. 37,484, 37,484 (Sept. 13, 1985) (to be codified at 40 C.F.R. pt. 50) (announcing

During its most recent review, EPA focused on capping at 2% the COHb levels resulting from one-hour carbon monoxide exposure.[255] It viewed this constraint as "a margin of safety against effects of concern that have been associated with higher COHb levels, such as 3–4% COHb."[256] The agency noted that under the existing standard "only a very small percentage" of the at-risk population is estimated to experience a single occurrence in a year of daily maximum COHb at or above 3%, and "only a small percentage" of the at-risk population is expected to experience a single occurrence of 2% COHb in a year.[257]

Thus, EPA retained the standards set in 1971. It concluded that they provide "a very high degree of protection" against the health effects of most concern, which are associated with high COHb levels.[258] With respect to health effects that occur at lower COHb levels, EPA found that the existing standards provide "slightly less but a still high degree of protection."[259] As in the case of ozone,[260] EPA rejected CASAC's recommendation that the standard be more stringent.[261]

As with the previous standards, EPA acknowledged that carbon monoxide is a nonthreshold contaminant, so that "the available health effects evidence generally reflects a continuum."[262] As a result, it chose to leave a "small percentage" of the population unprotected,[263] indicating, consistent with the stopping-point problem, that the size of the unprotected group is "largely a public health policy judgment."[264] EPA's decision to leave unprotected a larger group than its own sci-

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EPA's review of and decision not to revise the existing standards); National Ambient Air Quality Standards for Carbon Monoxide – Final Decision, 59 Fed. Reg. 38,906, 38,906 (Aug. 1, 1994) (to be codified at 40 C.F.R. pt. 50) (same); Carbon Monoxide 2011 Final Rule, *supra* note 167, at 54,294 (same). For a history of the various reviews, see *id*. at 54,295–96 (reviewing the air quality criteria and standards for carbon monoxide over time); *Carbon Monoxide (CO) Standards – Table of Historical CO NAAQS*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ttn/naaqs/standards/co/s_co_history.html (last updated June 11, 2013) (cataloguing the NAAQS for carbon monoxide from 1971 to 2011).

255 *See* Carbon Monoxide 2011 Final Rule, *supra* note 167, at 54,307.

256 *Id*.

257 *Id*. at 54,308.

258 *Id*.

259 *Id*.

260 *See supra* text accompanying note 199 (describing EPA's divergence from the CASAC recommendation on the standard for ozone).

261 *See* Carbon Monoxide 2011 Final Rule, *supra* note 167, at 54,304, 54,308 (distinguishing EPA's decisions from CASAC's recommendations and advice on the matter).

262 *Id*. at 54,308.

263 *Id*.

264 *Id*.

ence advisory board urged[265] would be irrational were it not for competing considerations that EPA did not—indeed, could not—reveal.

6. Particulate Matter

Particulate matter is a term used to describe a mixture of solid particles and liquid droplets found in the air. These particles can be large and visible—for example, dust, dirt, soot, or smoke—or smaller and less noticeable.[266] Particulate matter is both emitted directly from sources such as smoke stacks and construction sites, and formed in the air by chemical reactions involving other pollutants.[267]

There are ambient air quality standards for two types of particulate matter, determined by the size of the particles in the air. The first type, PM_{10} or "coarse particles," covers particles larger than 2.5 μm but smaller than 10 μm.[268] The second, $PM_{2.5}$ or "fine particles," covers particles smaller than 2.5 μm.[269] This distinction is significant because the size of the particles determines the health effect caused by inhalation.

A wide range of health effects is associated with exposure to particulate matter. For example, recent studies have found a "causal relationship" between $PM_{2.5}$ exposure and cardiovascular effects, including cardiovascular mortality.[270] There is also a "likely causal relationship" between both long-term and short-term exposure to $PM_{2.5}$ and respiratory effects, including respiratory-related mortality.[271] Furthermore, there is "suggestive" evidence of a "causal relationship" between long-term $PM_{2.5}$ exposures and various other health

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265 EPA acknowledged that CASAC had "expressed a preference for a lower[,] [more stringent] standard," yet it judged the "uncertainties and limitations" associated with the evidence to which CASAC had referred to be "too great . . . to provide a basis for revising the current standards." *Id*. at 54,304; *see also* National Ambient Air Quality Standards for Carbon Monoxide, 76 Fed. Reg. 8158, 8184–85 (proposed Feb. 11, 2011) (to be codified at 40 C.F.R. pts. 50, 53, 58) (describing a number of complications in the epidemiological evidence base which impact evaluation of the standards).

266 *See Particulate Matter (PM) – Basic Information*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/pm/basic.html (last updated Mar. 18, 2013) (defining particle pollution).

267 *See id*. (distinguishing primary particles, emitted directly from a source, from secondary particles, formed in complicated reactions in the atmosphere, of chemicals emitted from power plants, industrial sources, and automobiles).

268 Particulate Matter 2013 Final Rule, *supra* note 166, at 3086.

269 *Id.*

270 *Id.* at 3103; *see also* National Ambient Air Quality Standards for Particulate Matter, 77 Fed. Reg. 38,890, 38,906 (proposed June 29, 2012) (to be codified at 40 C.F.R. pts. 50, 51, 52, 53, 58) (discussing further the scientific evidence of cardiovascular-related morbidity and mortality linked to such exposures).

271 Particulate Matter 2013 Final Rule, *supra* note 166, at 3103.

effects including reproductive and developmental impacts and carcinogenic effects.[272]

EPA first promulgated the NAAQS for particulate matter in 1971, setting a standard that limited the concentration of Total Suspended Particles (TSP).[273] In 1987, EPA revised the standard and shifted to focus on PM_{10}.[274] A decade later, in 1997, the agency added the $PM_{2.5}$ standard,[275] and since then there have been two separate standards, which were both revised in 2006.[276] The $PM_{2.5}$ standard was revised again this past year.[277]

The $PM_{2.5}$ ambient air quality standard has two components: a "generally controlling" standard, based on an annual average,[278] and a standard with a twenty-four-hour averaging period, meant to provide supplemental protection against days with high "peak" concentrations.[279] The current review retained the latter (at a level of 35 $\mu g/m^3$) and revised the former, which had previously been set at 15 $\mu g/m^3$.[280]

In performing this revision, EPA considered a range of 12 to 13 $\mu g/m^3$,[281] and ultimately selected a standard of 12 $\mu g/m^3$.[282] EPA

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272 *Id.*

273 *See* 1971 NAAQS, *supra* note 97, at 8191–93 (setting out the reference method for the determination of suspended particulates in the atmosphere).

274 *See* Revisions to the National Ambient Air Quality Standards for Particulate Matter, 52 Fed. Reg. 24,634, 24,634 (July 1, 1987) (to be codified at 40 C.F.R. pt. 50) (announcing the replacement of TSP with PM_{10} as a new indicator).

275 *See* National Ambient Air Quality Standards for Particulate Matter, 62 Fed. Reg. 38,652, 38,652 (July 18, 1997) (to be codified at 40 C.F.R. pt. 50) (announcing the addition of two new $PM_{2.5}$ standards).

276 *See* National Ambient Air Quality Standards for Particulate Matter, 71 Fed. Reg. 61,144, 61,144 (Oct. 17, 2006) (to be codified at 40 C.F.R. pt. 50) (announcing revisions to the primary and secondary NAAQS for both fine and coarse particles).

277 *See* Particulate Matter 2013 Final Rule, *supra* note 166, at 3086 (summarizing the revisions made to the annual $PM_{2.5}$ standard). For a history of the various amendments, see *id*. at 3090–93; *Particulate Matter (PM) Standards – Table of Historical PM NAAQS*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_history.html (last updated June 11, 2013).

278 Particulate Matter 2013 Final Rule, *supra* note 166, at 3098.

279 *Id*.

280 *Id.* at 3086, 3098. EPA's decision in 2006 to keep in place the existing 15 $\mu g/m^3$ annual $PM_{2.5}$ standard was successfully challenged and remanded to the agency for further consideration. *See* Am. Farm Bureau Fed'n v. EPA, 559 F.3d 512, 522–24 (D.C. Cir. 2009) (finding that EPA failed to adequately explain the reasoning and methodology for its decision). The 2013 rule responds to this remand. *See* Particulate Matter 2013 Final Rule, *supra* note 166, at 3128–29 (describing the agency's general approach for considering standard levels, including consideration of issues raised in the remand).

281 *See* Particulate Matter 2013 Final Rule, *supra* note 166, at 3142 (stating EPA's rationale for considering a level within this range).

282 *Id.* at 3086.

acknowledged that there was no threshold for $PM_{2.5}$,[283] and went on to find that "there is no single factor or criterion that comprises the 'correct' approach to weighing" the evidence, but rather there are "various approaches that are appropriate to consider."[284] It determined that the most suitable approach for identifying a revised annual standard level was to characterize the part of the distribution of $PM_{2.5}$ concentrations for which it had "the most confidence in the associations reported in the epidemiological studies."[285]

EPA indicated that it was setting the standard at a level "somewhat below" the mean $PM_{2.5}$ concentrations reported in the key exposure studies, in order to provide appropriate protection against the observed effects.[286] The question that the agency faced, then, was how far below the lowest observed effects should it set the standard? EPA openly recognized that "there is no clear way to identify how much below the long-term mean concentrations [from studies] to set a standard."[287] EPA concluded that a standard of 12 $\mu g/m^3$ is below the mean $PM_{2.5}$ concentrations "reported in *each* of the key multi-city, long- and short-term exposures studies," and reflects "placing greatest weight on evidence of effects for which . . . there is a causal or likely causal relationship with long- and short-term $PM_{2.5}$ exposures."[288]

The stopping-point problem manifests itself in a somewhat different way in this rulemaking. Unlike for the ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide standards,[289] the discussion here was not framed in terms of how many individuals within the population would be left unprotected. Instead, EPA focused on the mean concentrations at which effects were observed and determined how far below this concentration it should set the standards. This decision gives rise to two of the sources of the stopping-point problem discussed in the context of the 1978 lead NAAQS.[290] Given standard distributions of how a population responds to a particular level of pollution, this decision is analytically identical to a decision concerning how many people should be subject to effects that EPA

283 *See id.* at 3158 (stating that "health effects may occur over the full range of concentrations observed . . . [and that] no discernible population-level threshold for any [health] effects can be identified based on the currently available evidence").

284 *Id*. at 3141, 3160.

285 *Id*. at 3129; *see also id.* at 3158 (elaborating on the relative degree of confidence in the significance of observed associations).

286 *Id*. at 3159.

287 *Id.*

288 *Id*. at 3161.

289 *See supra* text accompanying notes 195–97 (ozone), 214–19 (nitrogen dioxide), 247–48 (sulfur dioxide), 255–65 (carbon monoxide).

290 *See supra* Part II.B (discussing the aspects of EPA's decisionmaking that gave rise to the conditions for a stopping-point problem for the 1978 lead NAAQS).

regards as impermissible for an "average" member of the population.[291] Second, because evidence was not available for the agency to exclude effects below the lowest observed effect level, the health risks resulting from this scientific uncertainty were imposed on the population.[292] The Administrator provides no defense for her decision other than to say that, in light of the nonthreshold nature of the contaminant, she must "use her judgment."[293] Thus, once again, there is no coherent stopping point, because the health benefits of more stringent standards cannot be weighed against other social consequences.

III
Understanding the Problem

This Part explores certain important characteristics and consequences of the stopping-point problem. It first explains that the stopping-point problem is not limited to nonthreshold contaminants. Then, it shows why, despite its ambition, Justice Breyer's concurrence in *American Trucking* does not provide a solution to this problem. Finally, it argues that if the agency looks at costs surreptitiously, this practice of concealing the true basis for the agency's decisions undermines core values of administrative procedure.

A. Threshold Contaminants

As the prior section shows, EPA currently treats each of the six contaminants subject to the NAAQS as nonthreshold contaminants. For such contaminants, it is easy to see why EPA cannot make a coherent choice on the basis of health considerations alone. As we showed above, EPA's inquiry essentially consists of two steps. In the first, it determines what concentration of the pollutant would provide a given level of protection to a particular target group. In the second, it determines what proportion of the population should not receive this level of protection. We have explained why there is no defensible way of making either determination based on health considerations alone.[294]

But the problem is not confined to nonthreshold contaminants. As discussed in Part II.A, in 1978 EPA treated lead as a threshold contaminant. The agency determined the threshold by reference to an

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[291] *See supra* text accompanying notes 140–49 (discussing aspects of the agency's decisionmaking for which population diversity was an issue).

[292] *See supra* text accompanying notes 150–53 (discussing the risk imposed on the population due to EPA's selection of a point estimate for an uncertain parameter value).

[293] Particulate Matter 2013 Final Rule, *supra* note 166, at 3159.

[294] *See supra* Part II.B (identifying the inquiries in the agency's decisionmaking process that create a stopping-point problem).

"average" person exposed to nonair contributions around the midpoint of the range. Anyone living in parts of the country with higher nonair contributions would be exposed to lead levels above the threshold.[295] Thus, regional variation in the exposure to lead from nonair sources undermines the threshold.

Similarly, EPA selected the threshold to protect 99.5% of the population. By definition, the remaining 0.5% are exposed to a higher level of pollution.[296] Here, the threshold is undermined by differences across the population in the absorption of lead into the bloodstream.

Moreover, EPA defined the critical population on the basis of an "average" child aged one to five. As a result, children with particular sensitivities do not receive the requisite level of protection.[297] So, the threshold is undermined by differences across the population in the harm caused by a particular level of lead in blood.

As a result of these three phenomena, no nonzero standard would protect every person. So, even in the case of a contaminant that EPA chose to treat as a threshold contaminant, like the agency did for lead in 1978, no nonzero standard would protect every individual. Here too, the agency is left with no option but to decide what proportion of the population to place beyond the threshold and therefore expose to a public health harm. And, as we have already noted, there is no coherent way to perform this inquiry if health is the only factor that the agency can consider.[298]

B. Justice Breyer and Health-Wealth Tradeoffs

Justice Breyer, in his concurrence in *American Trucking*, presents a reading of the CAA that, at first glance, could be interpreted to avoid the stopping-point problem by allowing the agency to consider the *health* effects of imposing regulatory costs on the public. He states that the CAA "permits the Administrator to take account of comparative health risks" and "consider whether a proposed rule promotes safety overall."[299] According to Justice Breyer, a rule likely to cause

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[295] *See supra* text accompanying notes 147–48 (explaining that without an exceptionally stringent standard, some parts of the country will necessarily be exposed to levels above the threshold).

[296] *See supra* text accompanying note 143 (explaining that this percentage of the population included 20,605 children in central urban areas that would end up with levels of lead in the blood above 30 μg/dl).

[297] *See supra* text accompanying note 149 (discussing the diversity in susceptibility among different populations).

[298] *See supra* Part II.C (explaining that without considering nonhealth consequences, any decision allowing health risk lacks a justification).

[299] Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 495 (2001) (Breyer, J., concurring in part and concurring in the judgment).

more harm to health than it prevents is not a rule that is "requisite to protect the public health."[300] Justice Breyer then refers to an extreme situation: "Nor need regulation lead to deindustrialization. Preindustrial society was not a very healthy society; hence a standard demanding the return of the Stone Age would not prove 'requisite to protect the public health.'"[301]

Justice Breyer's argument is consistent with a prominent thread in the academic literature on health-wealth tradeoffs.[302] Proponents of this approach observe that there is a correlation between more wealth and better health. They therefore argue that regulations that are costly make people poorer and therefore less healthy. One influential study argues that "a regulation that costs more than $17.7 million to save a life kills more people than it saves."[303]

Under this approach, the tradeoff would not be between health and costs, which Justice Breyer agrees is a prohibited inquiry in setting the NAAQS, but between health and health: The health benefits of the regulation would be traded off against the health costs that are produced by the economic expenditures necessary to meet the regulation.

This approach could in theory provide a solution to the stopping-point problem. But there are a variety of practical and conceptual complications that make it deeply problematic.[304] The mere correlation between income and health is not enough to support a causal conclusion that a marginal increase in income will result in better health.[305] It may be that causation works in the opposite direction, and increased health leads to higher income because it allows people to work longer or have higher productivity.[306] Or, it could be that a third variable leads to both better health and more wealth. Indeed, the most careful empirical studies on the topic show that to be the case:

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[300] *Id.*

[301] *Id.* at 496.

[302] *See* REVESZ & LIVERMORE, *supra* note 14, at 71–75 (discussing academic literature).

[303] *Id.* at 69 (discussing Ralph L. Keeney, *Mortality Risks Induced by Economic Expenditures*, 10 RISK ANALYSIS 147 (1990)).

[304] In their recent defense of health-wealth tradeoffs, Christopher DeMuth and Judge Douglas Ginsburg skirt these complications with their claim that "[w]hen regulations direct resources toward health-improvement projects the government deems important, they also direct them, *to some degree*, away from health-improvement projects individuals deem important." Christopher C. DeMuth & Douglas H. Ginsburg, *Rationalism in Regulation*, 108 MICH. L. REV. 877, 889–90 (2010) (emphasis added). Perhaps, but the question of degree that DeMuth and Ginsburg leave entirely open is the central issue.

[305] REVESZ & LIVERMORE, *supra* note 14, at 71–72.

[306] *See* James M. Poterba, Steven F. Venti & David A. Wise, *The Asset Cost of Poor Health* (Nat'l Bureau of Econ. Research, Working Paper No. 16,389, 2010) (suggesting "large and substantively important correlations between poor health and asset accumulation").

Greater levels of education lead to both more wealth and better health.[307] The causal influence of income on health may be quite weak in developed countries with mature healthcare systems like the United States.[308]

Even where such a relationship exists, it is likely to depend on a range of specific factors, such as income levels and the existence of subsidized health insurance.[309] This fact raises the question of whether lowering regulatory stringency is the best way to achieve the goal of improving health outcomes, when redistributive tools may be more effective.[310] Furthermore, if health-wealth consequences are (as is likely) tightly linked to the distribution of regulatory costs, extremely sophisticated analysis will be necessary to tease out these effects. Not only would regulations with costs that fall mostly on high-income individuals have few health-wealth effects, rules that financially benefit the poor, for example by creating employment opportunities for low-skill workers, would result in increased health. Modeling these distributional effects ex ante is an extraordinarily complex analytic task, raising a host of practical hurdles for the agency, and may often find very small net effects.[311]

Justice Breyer may be correct that, were an air quality standard to be set so stringently that it utterly destroyed the economy, it would have negative overall effects on health. But for the kind of decisions that are actually presented to EPA, where the contemplated level of protection is constrained by political reality, there is no evidence that health-wealth tradeoffs are sufficiently grave that any but the highest possible level of stringency is justified. For extreme examples, the

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307 *See* Dana Goldman & James P. Smith, *The Increasing Value of Education to Health*, 72 SOC. SCI. & MED. 1728 (2011) (finding that in addition to having better health coverage, the more educated tend to adopt more healthful behaviors); James Smith, *Diabetes and the Rise of the SES Health Gradient* (Nat'l Bureau of Econ. Research, Working Paper No. 12,905, 2007) (finding that the more educated appear to be more able to adhere to diabetes therapies); JAMES P. SMITH, UNRAVELING THE SES-HEALTH CONNECTION 129 (2005) (suggesting that household income and wealth do not causally influence individual health outcomes).

308 *See* Jérôme Adda, Hans-Martin von Gaudecker & James Banks, *The Impact of Income Shocks on Health: Evidence from Cohort Data*, 7 J. EUR. ECON. ASS'N 1261 (2009) (suggesting that income has less of a causal influence in developed countries).

309 *See* DEBORAH LOWRY & YU XIE, SOCIOECONOMIC STATUS AND HEALTH DIFFERENTIALS IN CHINA: CONVERGENCE OR DIVERGENCE AT OLDER AGES? (Population Studies Center, Research Report 09-690, 2009) (finding that "due to certain socio-political factors, the influence of SES on health in prime ages is rather limited in China").

310 *See* REVESZ & LIVERMORE, *supra* note 14, at 74–75.

311 *See generally* DOES REGULATION KILL JOBS? (Cary Coglianese, Adam M. Finkel & Christopher Carrigan eds., 2013) (discussing the difficulty of modeling employment effects of regulation, with a frequent outcome being that positive and negative employment effects cancel each other out).

health-wealth concept could in principle provide a solution to the stopping-point problem. But if that point lies far outside the choice set of actual regulators, it is slim consolation.

C. Surreptitious Consideration of Costs

In the *American Trucking* litigation, the D.C. Circuit found that EPA lacked guidance for how to determine "how much is too much" pollution under the NAAQS.[312] It sought to resolve this dilemma by finding the statute unconstitutional.[313] The Supreme Court rejected the D.C. Circuit's holding that the NAAQS health-based standard provided the agency with an unconstitutionally broad delegation of power.[314] There is much to recommend in the Court's fairly circumspect interpretation of the non-delegation doctrine, given the reality that in a complex society, substantial discretion for administrative agencies is a necessary fact of life.[315]

The real problem is not the lack of guidance from Congress, but that EPA finds itself actively forbidden from engaging in the kind of balancing inquiry that it must undertake to set any level above zero for nonthreshold pollutants in a coherent way. In this connection, the Supreme Court decided that costs could not be taken into account in setting the NAAQS.[316] No party was able to propose a test that would allow the agency to stop short of an absolute level of stringency, yet none of the parties advocated setting the NAAQS at zero, and EPA showed "no inclination to adopt" such a strategy.[317]

Because the agency cannot acknowledge any factor other than health in its analysis, yet health alone cannot provide a complete

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312 Am. Trucking Ass'ns v. EPA, 175 F.3d 1027, 1034 (D.C. Cir. 1999), *rev'd sub nom* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001).

313 *Id.* at 1038.

314 *See* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 474 (2001) ("The scope of discretion that § 109(b)(1) allows is well within the outer limits of [the Court's] nondelegation precedents."); *id.* at 475 ("[E]ven in sweeping regulatory schemes we have never demanded, as the Court of Appeals did here, that statutes provide a 'determinate criterion' for saying 'how much [of the regulated harm] is too much.'" (second alteration in original)). The Court found that "[i]t is therefore not conclusive for delegation purposes that . . . ozone and particulate matter are 'nonthreshold' pollutants that inflict a continuum of adverse health effects at any airborne concentration greater than zero, and hence require EPA to make judgments of degree." *Id.*

315 For the same reason, we do not believe that the stopping-point problem renders EPA's decisions "arbitrary" or "capricious" for purposes of the Administrative Procedure Act. 5 U.S.C. § 706(2)(A) (2012). For a dissenting opinion on the nondelegation doctrine, see generally DAVID SCHOENBROD, POWER WITHOUT RESPONSIBILITY: HOW CONGRESS ABUSES THE PEOPLE THROUGH DELEGATION (1993) (arguing in favor of bringing back nondelegation for reasons such as transparency and accountability).

316 *See Am. Trucking Ass'ns*, 531 U.S. at 468–69.

317 *Am. Trucking Ass'ns*, 175 F.3d at 1034.

answer to the regulatory question that it faces, it *must* engage in an unacknowledged consideration of nonstatutory factors to arrive at a final outcome. There is, therefore, a necessary gap between the actual decisionmaking process and the reasons that the agency may give for its final decision.

George Eads, who served on the Council of Economic Advisors during the Carter Administration, argued shortly after leaving office that setting the NAAQS without regard for costs is impractical due to the absence of thresholds. Since there is no "safe" level, the only truly protective standard would be zero pollution. He notes, however, that such a standard would be prohibitively expensive. It is therefore unrealistic to expect the agency to impose a zero-pollution standard. Eads argues that, as a result, EPA does in fact take costs into account even though it is forced to pretend that it is not doing so:

> When decisions having such enormous potential economic consequences for the country are being made, it is foolish to pretend that economic concerns will not enter into the decision-making process. Indeed, it is positively deceitful to require that the economic considerations which do influence the Administrator's decision be hidden from public view.[318]

Likewise, C. Boyden Gray, former Counsel to President George H.W. Bush, argued as follows:

> The plain fact is that the EPA has for a long time considered costs and benefits in setting ambient standards—only it has done so behind closed doors in a manner that should never be tolerated in an open and democratic society and that has perversely impeded some of the clean air objectives the Agency is supposed to promote.[319]

Brian Mannix, EPA policy director under Administrator Johnson, recalls that before a briefing about the 2008 standard for ozone, the

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[318] *Clean Air Act Oversight: Hearings Before the Comm. on Envtl. and Pub.Works*, U.S. Senate, 97 Cong. 199 (1981) (statement of George C. Eads); *see also* George C. Eads, *The Confusion of Goals and Instruments: The Explicit Consideration of Cost in Setting National Ambient Air Quality Standards*, *in* TO BREATHE FREELY: RISK, CONSENT, AND AIR 228–29 (Mary Gibson ed., 1985) ("[I]n order to develop a standard that would stand up in court, [the EPA Administrator] was forced to pretend (though the pretense was relatively transparent in this case) that costs did not play an overt role in his decision."). As a result, "the public lost the chance to examine the role that cost—as opposed to other factors—did play in influencing his judgment."). For similar perspectives, see Joseph M. Feller, *Non-Threshold Pollutants and Air Quality Standards*, 24 ENVTL. L. 821, 833 (1994) (suggesting that if all costs were ignored, no risk would be acceptable); Richard J. Pierce, Jr., *The Appropriate Role of Costs in Environmental Regulations*, 54 ADMIN. L. REV. 1237, 1265–66 (2002) (noting that the Administrator considers costs while denying that he does so, as it is impossible to make a rational decision without considering costs).

[319] C. Boyden Gray, *The Clean Air Act Under Regulatory Reform*, 11 TUL. ENVTL. L.J. 235, 235 (1998).

Administrator turned to him and said "don't tell me what the costs are, but if it looks like I'm about to make a decision that ends civilization as we know it—please kick me under the table."[320] The request was meant as a joke, but as Mannix points out, it highlights the sense of "helplessness and unease" that EPA feels in the face of such an "absurd" statutory mandate.[321] Consistent with these positions, parties to the *American Trucking* case argued to the Court, unsuccessfully as it turned out, that because EPA was taking costs into account surreptitiously, it should be permitted to do so explicitly.[322]

D. Obstruction of Reason Giving

The unacknowledged consideration of a factor such as cost has obvious negative consequences for the transparency, accountability, and soundness of agency decisionmaking. Because reason giving is so "central to U.S. administrative law and practice,"[323] commentators have advanced many arguments in favor of its virtues. Some of the classic justifications for reason giving include limiting the scope of agency discretion, promoting transparency in government, and legitimating the exercise of administrative discretion.[324] Reason-giving requirements have also been defended as a means of improving the quality of agency decisionmaking directly, for example, by forcing agencies to examine issues they might otherwise ignore.[325]

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320 *Is EPA's NAAQS Process Inexorably Monotonic?*, THE FEDERALIST SOCIETY (Sept. 9, 2013), http://www.fed-soc.org/audiolib/isepasnaaqsprocessinexorablymonotonic-9-9-13.mp3 (audio podcast).

321 *Id.*

322 *See* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 471 n.4 (2001) ("If such an allegation could be proved, it would be grounds for vacating the NAAQS, because the Administrator had not followed the law."). Specifically, one amicus brief written by the AEI-Brookings Joint Center for Regulatory Studies on behalf of prominent academics spanning the political spectrum, became known as "the economists' brief." It notes that "it would be imprudent for the EPA to ignore costs totally . . . especially when there is no threshold level below which health risks disappear." Brief for AEI-Brookings Joint Ctr. for Regulatory Studies et al. as Amici Curiae Supporting Cross-Petitioners at 11, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015407.

323 Jodi L. Short, *The Political Turn in American Administrative Law: Power, Rationality, and Reasons*, 61 DUKE L.J. 1811, 1813 (2012).

324 *See* Glen Staszewski, *Reason-Giving and Accountability*, 93 MINN. L. REV. 1253, 1279–84 (2009) (providing a summary of arguments in favor of reason-giving); *see also* Martin M. Shapiro, *The Giving Reasons Requirement*, 1992 U. CHI. LEGAL F. 179, 180 (1992) (noting that reason-giving requirements improve the decisions made by administrators and enhance democratic influences); Cass R. Sunstein, *Naked Preferences and the Constitution*, 84 COLUM. L. REV. 1689, 1695 (1984) (explaining that a reasoned decisionmaking requirement helps reduce official self-dealing and "naked preferences" for one group over another).

325 *See, e.g.*, Cass R. Sunstein, *Cognition and Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1059, 1091 (2000) (discussing these arguments in favor of reason-giving).

The current structure of the NAAQS undermines these objectives. Any discretion-limiting feature of the reason-giving requirement cannot operate if the agency is precluded from divulging its true rationale. Transparency cannot be promoted if the actual factors relied on by the agency are obscured from public view and the agency is incentivized to conceal its policy judgments deep within technical support documents that purport to make only scientific determinations[326] or by talismanic references to "public health policy judgments."[327]

Legitimacy is hardly promoted by requiring agencies to provide a set of reasons to the polity that cannot logically provide a justification for the decision that was reached. Perhaps worst of all from the perspective of policy outcomes, agencies are discouraged from bringing the full force of their analytic resources to bear on the most relevant questions, spending substantial effort examining one dimension of the problem while consideration of other factors is implicitly left to intuition or gut instinct.

EPA's inability to divulge the genuine reasons behind its chosen standard also interferes with the process of judicial review. The Supreme Court in *American Trucking* was, in fact, implicitly presented with two unattractive alternatives: striking down the statute or according agencies extremely broad deference to select a standard without providing adequate justification. The Court wisely chose to foreclose the nondelegation option, finding that Congress has the constitutional power to grant wide discretion to administrative agencies. But, under the Administrative Procedure Act's "arbitrary and capricious" standard, broad discretion is supposed to be accompanied by probing review of the decisionmaking process.[328] Such review is

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[326] *See* Holly Doremus, *Science Plays Defense: Natural Resource Management in the Bush Administration*, 32 ECOLOGY L.Q. 249, 290 (2005) (noting that environmental "decisions that are in fact primarily political [can] be disguised as scientific ones"); J.B. Ruhl, *Reconstructing the Wall of Virtue: Maxims for the Co-Evolution of Environmental Law and Environmental Science*, 37 ENVTL. L. 1063, 1067 (2007) ("People fear . . . that scientists will use the objectivity virtue of science to dispense with the fairness and transparency of the law."); J.B. Ruhl & James Salzman, *In Defense of Regulatory Peer Review*, 84 WASH. U. L. REV. 1, 59 (2006) (promoting peer review to help reveal scientific bases of agency decisions); Wendy E. Wagner, *Administrative Law, Filter Failure, and Information Capture*, 59 DUKE L.J. 1321, 1324–25 (2010) (arguing that the demand for information in the agency decisionmaking process inadvertently creates incentives for participants to overwhelm the administrative system with complex information, thus reducing transparency).

[327] *See supra* text accompanying notes 161–75 (suggesting that with inadequate criteria for a final decision, the agency is forced to make "public health policy judgments").

[328] *See supra* text accompanying note 98 (discussing "hard look" review).

thwarted when the statutory standard prevents the agency from disclosing the criteria it used to actually arrive at its decision.[329]

More recent accounts of reason giving have focused on its institutional consequences: how "reason giving constitutes agencies as organizations, shaping everything from routine staffing decisions to agency culture" and how "reason giving structures agencies' interactions with citizens and with other legal and political institutions."[330] Different reason-giving requirements also play a role in determining "the relative influence" of different epistemic communities (scientists, lawyers, economists) as well as administrative tiers (political appointees, midlevel bureaucrats) within agencies.[331]

It is possible that advocates of health-based standards see an advantage in the institutional consequences of the current situation. For example, they might believe that the exclusive focus on public health places more power in the hands of scientists instead of economists or in the hands of career staff instead of political appointees. If the allocation of decisionmaking authority in an agency is simply a zero-sum game, interest groups might find that certain types of officials are more likely to exercise authority in ways that they favor, and support standards that give those officials greater say in the final decision. On this line of thinking, reason-giving would not promote more public-spirited outcomes. Rather, certain types of reason-giving requirements could promote (or harm) the public interest depending on which constituencies within agencies were empowered. Under this realist account, in which deliberation among groups is a cover for raw interest group politicking, health-based standards would be justified if they allocated power in such a way that the interests and desires of the general public were promoted.

But there is a serious problem with this final hypothesis: As Part IV shows, groups that favor health-based standards do not seem to benefit from the current arrangements. While environmentalists have been the strongest supporters of health-based standards, it turns out that the application of standard economic rationality in the form of

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[329] *See* David W. Barnes, *Back Door Cost-Benefit Analysis Under a Safety-First Clean Air Act*, 23 NAT. RESOURCE J. 827, 856–57 (1983) (criticizing the "subterfuge of back door cost-benefit analysis" in setting clean air standards and noting that "society might be better off with explicit cost-benefit analysis in setting the air quality standards from the start and abandoning as giving an inferior result the safety-first approach"); Coglianese & Marchant, *supra* note 8, at 1345 ("Given that EPA almost certainly considers costs implicitly when determining the level of its standards, the question arises whether society would be better served if the Agency began to consider cost estimates explicitly.").

[330] Short, *supra* note 323, at 1862.

[331] Elizabeth Magill & Adrian Vermeule, *Allocating Power Within Agencies*, 120 YALE L.J. 1032, 1035 (2010).

cost-benefit analysis would have delivered more protective NAAQS in most of the cases.

IV
Inadequacy Paradox

This Part examines the most recent round of rulemaking for five of the six NAAQS pollutants: lead, nitrogen oxide, sulfur dioxide, particulate matter, and ozone. We do not analyze the carbon monoxide standard because EPA has not conducted a monetized cost-benefit analysis in the last two reviews of the standard.[332]

Examining the Regulatory Impact Analyses (RIAs) accompanying the most recent NAAQS for each of the regulated pollutants leads to a striking conclusion, on which this Part focuses: If the standards had been set according to cost-benefit analysis, they would have been more stringent in four out of the five cases.[333] Health-based standards have been promoted rigorously by environmental groups and vehemently opposed by industry.[334] This behavior can be explained only by reference to a belief held by both groups that health-based standards will lead to more stringent environmental standards. But we show that this belief does not match the empirical reality, despite the contrary views of sophisticated interest groups with a substantial stake in the matter. First, though, we explain our methodological approach.

A. Methodology

As discussed above, EPA bifurcates the process for setting the NAAQS, with one group of agency officials working on the standard-setting process, and another group drafting an RIA.[335] Moreover,

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[332] No RIA was performed during the most recent review of the carbon monoxide standard in August 2011. E-mail from Tom Walton, Economist, Air Benefit & Cost Group, HEID/OAQPS/OAR/EPA (Sept. 12, 2012) (on file with the New York University Law Review). EPA had performed an RIA during its 1985 review of the standard but did not monetize the benefits. *See* U.S. Envtl. Prot. Agency, Regulatory Impact Analysis of the National Ambient Air Quality Standards for Carbon Monoxide, EPA-450/5-85-007, 19 (1985).

[333] Cost-benefit analysis "does not provide uncontestable insights into the effects of regulation," and there are "hard methodological choices in any sophisticated analysis." Michael A. Livermore, *Cost-Benefit Analysis and Agency Independence*, 81 U. Chi. L. Rev. 609 (2014). The claim below is not that any cost-benefit analysis of the NAAQS would have shown that a more stringent standard was justified. Rather, we show that EPA's own analysis, utilizing the methodologies that were developed and endorsed by the agency itself, found that the NAAQS that were selected were inefficiently weak in 80% of the relevant cases.

[334] *See supra* Part I.B.

[335] *See supra* text accompanying notes 21–26 (discussing the requirement to perform a cost-benefit analysis) and notes 79–88 (discussing the prohibition to consider costs in setting the NAAQS). EPA explains that the "deliberations with the Administrator

EPA explains that the cost-benefit analysis is done solely for informational purposes and that the final decision on the standard is not in any way based on the RIA.[336]

In addition to the final standard, EPA also evaluates both a less stringent and a more stringent alternative for each pollutant. In performing our analysis, we compare the net benefits of each one of these alternative standards. For each alternative examined, EPA also typically provides a range of expected annual benefits and a range of expected annual costs. Generally, the agency analyzes a scenario using a 3% discount rate and another one using a 7% discount rate, as required by the Office of Management and Budget (OMB).[337] In the Tables below, the net benefits for each standard are computed in the following manner. We determine the midpoint of the ranges of benefits and costs, respectively. Then, we subtract the midpoint of costs from the midpoint of benefits to provide the net-benefit midpoint. We could not employ a more sophisticated statistical technique to combine the various estimates because the RIAs do not contain descriptions of the distributions of costs and benefits, reporting instead the endpoints of the ranges.[338] We perform this analysis for both the 3% and 7% discount rates. Lastly, the net benefits of the two discount rates are averaged to provide a combined estimate of net benefits.[339] Our analysis is based on this latter figure. As the Tables below show,

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regarding review of the NAAQS standards do not include information regarding costs that might be associated with meeting different standards." E-mail from Darryl A. Weatherhead, Group Leader, Air Economics Group, HEID/OAQPS/OAR/EPA (Sept. 3, 2013) (on file with New York University Law Review).

336 EPA notes that "although an RIA has been prepared, the results of the RIA have not been considered in issuing this final rule." Lead 2008 Final Rule, *supra* note 102, at 67,046. For similar language, see Particulate Matter 2013 Final Rule, *supra* note 166, at 3089; Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6527; Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,587; Ozone 2008 Final Rule, *supra* note 163, at 16,505.

337 OFFICE OF MGMT. AND BUDGET, CIRCULAR A-4, REGULATORY ANALYSIS: MEMORANDUM TO THE HEADS OF EXECUTIVE AGENCIES AND ESTABLISHMENTS 34 (Sept. 17, 2003) [hereinafter CIRCULAR A-4].

338 The RIAs define the bottom and top ends of the range by relying on alternative sets of assumptions about the control costs and benefits, but do not indicate what the distribution within each range might be. For example, for the particulate matter standard, EPA explains that the range of costs reflects estimates generated by two different cost-evaluation methodologies, and the range of benefits reflects the central estimates from two different studies. U.S. ENVTL. PROT. AGENCY, REGULATORY IMPACT ANALYSIS FOR THE FINAL REVISIONS TO THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER, EPA-452/R-12-005, at ES-15 tbl.ES-2 & nn.b & d, ES-18–19, ES-25 (2012) [hereinafter PM RIA].

339 *See* Richard G. Newell & William A. Pizer, *Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?*, 46 J. ENVTL. ECON. & MGMT. 52, 53–54 (2003) (discussing the correct method to estimate expected utility in the face of uncertain discount rates).

only in the case of lead do the results depend on the choice between the two discount rates.[340] Thus, for the other cases, our conclusion does not depend on the protocol used to combine the analyses performed under the two rates.

For purposes of our analysis, we assume that the RIAs would not be substantially different if they were used as the basis for choosing the standard. We recognize that the interactions between EPA and the relevant interest groups might be different.[341] But the RIAs are prepared according to a standardized set of methodologies and pursuant to well-established professional norms.[342] Therefore, it would be difficult for EPA to depart from these in individual cases. More specifically, the main benefit for the NAAQS is the value of the human lives saved,[343] which is the product of the number of lives saved times the value assigned to each life, known as the Value of a Statistical Life (VSL). There is a well-accepted standard VSL—around $8 million—that is used relatively consistently across the federal government.[344] EPA would not be able to materially depart from it without attracting strong scrutiny and criticism. Moreover, the estimate of the number of lives saved comes from risk assessments that are also relevant for EPA's current public health inquiry.[345] The regulated community,

340 *See generally infra* Part IV.B.

341 For discussion of how a different status for RIAs might affect the behavior of interest groups, see Matthew D. Adler, *The Positive Political Theory of Cost-Benefit Analysis: A Comment on* Johnston, 150 U. PA. L. REV. 1429, 1435–36 (2002); Jason Scott Johnston, *A Game Theoretic Analysis of Alternative Institutions for Regulatory Cost-Benefit Analysis*, 150 U. PA. L. REV. 1343, 1370–78 (2002).

342 Livermore & Revesz, *supra* note 26, at 1370–72.

343 For example, for the particulate matter standard EPA notes that the estimated benefits "reflect the sum of the economic value of estimated $PM_{2.5}$ mortality impacts identified and the value of all morbidity impacts," PM RIA, *supra* note 338, at 5-1, and that "the reduction in premature deaths each year accounts for over 90% of total monetized benefits." *Id.* at ES-15 tbl.ES-2. Likewise, for the nitrogen dioxide standard, EPA explains that mortality benefits (in this case related to PM co-benefits) "represent a substantial proportion of total monetized benefits (over 90%)." U.S. ENVTL. PROT. AGENCY, FINAL REGULATORY IMPACT ANALYSIS (RIA) FOR THE NO_2 NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS), ES-10 (2010) [hereinafter NITROGEN DIOXIDE RIA]. There is similar language in the sulfur dioxide RIA as well. *See* U.S. ENVTL. PROT. AGENCY, FINAL REGULATORY IMPACT ANALYSIS (RIA) FOR THE SO_2 NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS), ES-12 (2010) [hereinafter SULFUR DIOXIDE RIA] (stating that $PM_{2.5}$ mortality co-benefits represent over 99% of total monetized benefits).

344 *See* Richard L. Revesz, *Quantifying Regulatory Benefits*, 102 CALIF. L. REV. (forthcoming Dec. 2014) (noting that EPA uses, for example, $7.4 million in 2006 dollars).

345 The conclusion of Part II is *not* that uncertainties concerning the health effects of criteria pollutants render EPA's judgments incoherent, but instead that health-based standards do not provide the agency with any means to balance uncertainty against other social considerations. Thus, if there is *any* risk that a pollutant at a very low concentration has an adverse health effect, a cost-blind analysis would require that the risk be eliminated (a step that the agency has consistently decided not to take). Cost-benefit analysis using

therefore, already has incentives to question those estimates. It is not clear how the use of the RIAs as a decisional tool would add to those incentives. With this background in mind, we turn to an analysis of the five NAAQS.

B. Socially Optimal Level of Pollution

We show here that for two of the NAAQS (lead and particulate matter), cost-benefit analysis would have led to more stringent standards even if only the direct benefits of the regulation were considered. For two other standards (nitrogen dioxide and sulfur dioxide), more stringent standards would be justified on the basis of the sum of both the direct benefits and the ancillary benefits, or co-benefits. The latter are benefits that accrue as a result of the target reductions although they were not the direct objective of the regulation.[346] OMB requires in its Circular A-4 that such ancillary benefits be taken into account in the evaluation of regulations.[347]

1. Lead

In the regulatory impact analysis of the 2008 lead standard, the agency examined (in addition to the final standard of 0.15 $\mu g/m^3$) both a more stringent level of 0.10 $\mu g/m^3$ and a less stringent alternative of 0.40 $\mu g/m^3$. The estimates of costs and benefits varied greatly. Two factors drove this variation. First, the discount rate had a large effect on the value assigned to IQ gains from the new standard. For

expected utility as the measure of value has an entirely different approach to uncertainty and risk. Under this framework, a harm is discounted by its probability, and that expected harm is compared to the expected costs of the rule, with the goal of maximizing expected net benefits. Treatment of uncertainty that is not justified under a harm-based standard—for example, selecting a point estimate from along a range of values—might be quite consistent with a cost-benefit approach.

346 *See* REVESZ & LIVERMORE, *supra* note 14, at 58–61 (discussing examples of ancillary benefits in environmental and health-and-safety regulation). For example, in the context of air pollution, the regulation of greenhouse gases would also result in reductions in conventional pollutants including ozone, nitrogen oxide, and sulfur dioxide. *Id.* at 59; *see also* RISK VS. RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT 232 (John D. Graham & Jonathan Baert Wiener eds., 1995) (discussing the coincident benefits of carbon monoxide reductions); Samuel J. Rascoff & Richard L. Revesz, *The Biases of Risk Tradeoff Analysis: Towards Parity in Environmental and Health-and-Safety Regulation*, 69 U. CHI. L. REV. 1763, 1823–34 (2002) (using the ancillary benefits of policies targeting conventional pollutants as a case study).

347 CIRCULAR A-4, *supra* note 337, at 3, 12, 26. To guard against double counting the ancillary benefits, one needs to make sure that after each regulation is promulgated, a new baseline level of pollution is computed. Then, the further benefits from subsequent regulations need to be determined by reference to this baseline. On a related point, social welfare could be enhanced if all the NAAQS were optimized at the same time, instead of sequentially. But the administrative burden would be enormous and the statutory timetables might not allow it.

example, as Table 1 shows, using a 3% discount rate, the yearly benefits of the final standard were found to range between $3700 million and $6900 million; using a 7% discount rate, the benefits were estimated to be between $650 million and $2600 million per year. The second factor was the methodology used by EPA to extrapolate the costs of emissions reductions where no existing technology was available to meet the standard. One method, based on a regression analysis of existing control technologies that predicted the costs of further reductions, resulted in a relatively low estimate of between $150 million and $170 million for the final standard.[348] A second method, based on an average cost per microgram of air quality improvement at seven monitor areas, resulted in a substantially higher estimate of $2800 million to $3200 million.[349]

Analyzing the net benefits reveals the following results. For the 7% discount rate, the less stringent alternative of 0.4 $\mu g/m^3$ has higher net benefits: $539 million compared to -$60 million for the final standard, or -$205 million for the more stringent alternative of 0.1 $\mu g/m^3$. In contrast, for the 3% discount rate, increasing the stringency of the standard also increases the net benefits. The net benefits of the less stringent alternative are $2660 million, as compared to net benefits of $3825 million for the final standard and $4855 million for the more stringent alternative. And, likewise, when looking at the midrange of the 3% and 7% scenarios, the more stringent alternative yielding $2325 million in net benefits dominates both the final standard and the less stringent alternative, which yield $1882 million and $1600 million in net benefits, respectively. As a result, the application of cost-benefit analysis would have resulted in a more stringent standard than the one the agency promulgated when taking into account only public health considerations.

348 U.S. ENVTL. PROT. AGENCY, REGULATORY IMPACT ANALYSIS OF THE PROPOSED REVISIONS TO THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR LEAD, tbl.ES-2 at ES-11 (Oct. 2008) [hereinafter LEAD 2008 RIA] (including control costs); *id*. at 6-15 to 6-16 (describing cost-curve approach).

349 *See id.* at tbl.ES-2 at ES-11 (including control costs).

TABLE 1
COST-BENEFIT ANALYSIS OF THE LEAD 2008 STANDARDS
(MILLIONS OF 2006$)

	Less stringent alternative: 0.4 μg/m^3		Final standard: 0.15 μg/m^3		More stringent alternative: 0.1 μg/m^3	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Range of benefits	2100–3700	350–1300	370–6900	650–2600	4800–8600	800–3100
Benefits midpoint	*2900*	*825*	*5300*	*1625*	*6700*	*1950*
Range of costs	50–430	61–510	150–2800	170–3200	190–3500	210–4100
Costs midpoint	*240*	*285*	*1475*	*1685*	*1845*	*2155*
Net benefits midpoint	*2660*	*539*	*3825*	*-60*	*4855*	*-205*
Midpoint of 3% and 7% net benefits	*1600*		*1882*		*2325*	

2. Nitrogen Dioxide

In addition to the final standard of 100 ppb, EPA examined a more stringent alternative of 80 ppb and a less stringent alternative of 125 ppb. As Table 2 shows, the agency estimated the costs and the benefits for both the final standard and the less stringent alternative as zero, explaining that "[f]or the selected standard of 100 ppb, there would be zero costs and benefits as we project all areas to attain this standard without additional controls."[350] Although EPA includes in the analysis $3.6 million monitoring costs for all standards,[351] these costs are subtracted here because they do not affect the choice among the standards. The analysis, therefore, focuses only on the benefits and costs of the standard itself.

The benefits reported for the more stringent option are in fact the ancillary benefits, not the direct benefits, expected to accrue from the reduction of nitrogen dioxide. EPA explained that it was "unable to estimate the health benefits of reduced NO_2 exposure," but was able to estimate the benefits from reduced particulate matter exposure that would result from reductions in nitrogen dioxide.[352] To calculate the $PM_{2.5}$ ancillary benefits, EPA used a "benefit per-ton" method to provide the estimates, since due to "analytical limitations" EPA found

[350] NITROGEN DIOXIDE RIA, *supra* note 343, at 4-1.
[351] *Id*. at ES-6, tbl.ES-1 (3% discount rate), ES-7, tbl.ES-2 (7% discount rate).
[352] *Id*. at 4-3.

that it was not possible to offer a comprehensive estimate of $PM_{2.5}$ benefits.[353]

The more stringent standard of 80 ppb had expected net benefits of $3 million under the 3% discount rate, $2.5 million under the 7% discount rate scenario, and $2.7 million for the midpoint between the two discount rates, as compared with zero net benefits for both the final standard and the less stringent alternative.[354] Here, too, the application of cost-benefit analysis would have led to a more stringent standard.

TABLE 2
COST-BENEFIT ANALYSIS OF THE NITROGEN DIOXIDE 2010 STANDARDS (MILLIONS OF 2006$)

	Less stringent alternative: 125 ppb		Final standard: 100 ppb		More stringent alternative: 80 ppb	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Range of benefits	0–0	0–0	0–0	0–0	3.5–8.6	3.2–7.8
Benefits midpoint	*0*	*0*	*0*	*0*	*6.1*	*5.5*
Range of costs	0–0	0–0	0–0	0–0	2–4.1	2–4.1
Costs midpoint	*0*	*0*	*0*	*0*	*3.1*	*3.1*
Net benefits midpoint	*0*	*0*	*0*	*0*	*3*	*2.5*
Midpoint of 3% and 7% net benefits	*0*		*0*		*2.7*	

[353] *Id*. The marginal costs of incrementally higher standards were estimated at between $3000 and $6000 per ton of nitrogen oxides reduced. *Id*. at ES-5. The corresponding benefits were estimated at between $5200 and $13,000 per ton using a 3% discount rate, and between $4700 and $11,000 using a 7% discount rate. *Id*. at 4–12 tbl.4-3. Estimates of the tons reduced were determined by the gradient of the emissions forecast function: EPA adjusted the available data from area-wide monitors to reflect the expected values for near-road monitors using different gradients. *Id*. at ES-3. The more stringent 80 ppb standard was assumed to reduce between zero (for 30% gradient) and 21,000 tons (for 100% gradient) of NO_2 compared to the standard set by the final rule. *Id.* at ES-6 tbl.ES-1 (discounting benefits at 3%), ES-7 tbl.ES-2 (discounting benefits at 7%).

[354] All cost estimates used a 3% discount rate. The range of benefits refers to the mean gradient of 65%. *Id*. at ES-6 tbl.ES-1 (discounting benefits at 3%), ES-7, tbl.ES-2 (discounting benefits at 7%). The more stringent alternative of 80 ppb would also have higher net benefits than the final and the less stringent alternatives under the 100% gradient. *Id.* Additionally, it would have the same net benefits as the other standards under the 30% gradient. *Id*.

3. Sulfur Dioxide

In addition to the final standard of 75 ppb, EPA also examined a more stringent alternative of 50 ppb and a less stringent standard of 100 ppb. Table 3 shows that the more stringent alternative is preferable under cost-benefit analysis.

The agency quantified some of the direct health benefits associated with reductions in sulfur dioxide exposure, but they were very small compared to the ancillary benefits produced by the corresponding reduction of particulate matter. For example, for the final standard, EPA estimated the benefits of sulfur dioxide reductions to be $2.2 million under both discount rates.[355] In contrast, the range of benefits for particulate matter reduction is $15,000–37,000 million under the 3% discount rate and $14,000–34,000 million for the 7% discount rate.[356]

Here, again, increasing the stringency of the standard would have increased the net benefits. Under the 3% discount rate, the least stringent standard would have resulted in net benefits of $11,971 million, whereas the final standard had net benefits of $24,502 million, and the more stringent alternative had net benefits of $54,108 million. This pattern is true also for the 7% discount rate, where the most stringent standard had the highest net benefits, followed by the final standard. And, likewise, under the midpoint of the two discount rates, increasing the stringency of the standard would have increased the net benefits: $11,296 million for the less stringent alternative, $23,502 million for the final standard, and $51,358 million for the more stringent alternative. As in the case of lead and nitrogen dioxide, the application of cost-benefit analysis would have led to a more stringent standard.

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[355] SULFUR DIOXIDE RIA, *supra* note 343, at ES-9. EPA explains that "[b]ecause all SO_2-related benefits are short-term effects, the results are identical for all discount rates." *Id*. at ES-9 tbl.ES-4.

[356] *Id*.

TABLE 3
COST-BENEFIT ANALYSIS FOR SULFUR DIOXIDE 2010 STANDARD (MILLIONS OF 2006$)

	Less stringent alternative: 100 ppb		Final standard: 75 ppb		More stringent alternative: 50 ppb	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Range of benefits	7401–18,001	6701–16,001	15,002–37,002	14,002–34,002	34,008–83,008	31,008–75,008
Benefits midpoint	*12,701*	*11,351*	*26,002*	*24,002*	*58,508*	*53,008*
Costs	730	730	1500	1500	4400	4400
Net benefits midpoint	*11,971*	*10,621*	*24,502*	*22,502*	*54,108*	*48,608*
Midpoint of 3% and 7% net benefits	*11,296*		*23,502*		*51,358*	

4. Particulate Matter

Here, too, a cost-benefit analysis would lead to a more stringent standard. In addition to analyzing the final standard of 12 $\mu g/m^3$, EPA examined a less stringent alternative of 13 $\mu g/m^3$ and a more stringent alternative of 11 $\mu g/m^3$.[357] As Table 4 shows, under the 3% discount rate, the less stringent alternative has net benefits of $2045 million, as compared to $6349 million for the final standard and $19,990 million for the more stringent alternative. Similarly, under the 7% discount rate, the less stringent alternative produces net benefits of $1845 million, as compared to $5699 million for the final standard and $17,990 million for the more stringent alternative. Thus, the more stringent alternative also performs best for the midpoint of the 3% and 7% discount rates, with net benefits of $1945 million for the less stringent alternative, $6024 million for the final standard, and $18,990 million for the more stringent alternative. Again, the application of cost-benefit analysis would have led to a more stringent standard.

[357] PM RIA, *supra* note 338, at ES-13–15.

TABLE 4
COST-BENEFIT ANALYSIS OF PARTICULATE MATTER 2013 STANDARDS (MILLIONS OF 2010$)

	Less stringent alternative: 13 μg/m^3		Final standard: 12 μg/m^3		More stringent alternative: 11 μg/m^3	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Range of benefits	1300–2900	1200–2600	4000–9100	3600–8200	13,000–29,000	12,000–26,000
Benefits midpoint	*2100*	*1900*	*6550*	*5900*	*21,000*	*19,000*
Range of costs	11–100	11–100	53–350	53–350	320–1700	320–1700
Costs midpoint	*55*	*55*	*201*	*201*	*1010*	*1010*
Net benefits midpoint	*2045*	*1845*	*6349*	*5699*	*19,990*	*17,990*
Midpoint of 3% and 7% net benefits	*1945*		*6024*		*18,990*	

5. Ozone

As Table 5 shows, in addition to the final standard of 0.075 ppm, EPA evaluated a less stringent alternative of 0.079 ppm and two more stringent alternatives of 0.07 ppm and 0.065 ppm, respectively. For each option, EPA provided benefit estimates for each of five mortality functions.[358] As a result, for each alternative standard and for each discount rate, there were in fact five ranges of benefits, one for each of these mortality functions. To calculate the benefits for each of the four standards (and for each of the discount rates), we averaged the low ends of the ranges for each of the mortality functions and used the resulting figure as the low end of the benefits for the standard. Then, we averaged the high ends of the ranges and used the resulting figure as the high end of the benefits for the standard. The remaining calculations (finding the midpoint of the ranges and calculating the net benefits) were conducted in the same manner as for the other pollutants.[359]

[358] U.S. ENVTL. PROT. AGENCY, FINAL OZONE NAAQS REGULATORY IMPACT ANALYSIS, EPA-452/R-08-003, ES-4–7 (Mar. 2008) [hereinafter OZONE RIA]. The cost estimates, in contrast, were the same for each of the mortality functions. *Id*. The mortality functions represent different estimates for ozone and $PM_{2.5}$-related premature mortalities and morbidities avoided nationwide in 2020. *Id*. at ES-5, ES-6 tbl.ES-5.

[359] EPA calculated the costs only for a 7% discount rate, explaining that the "[d]ata for calculating costs at a 3% discount rate was not available for all sectors, and therefore total annualized costs at 3% are not presented here." *Id.* at ES-5 tbl.ES.4.

The 2008 ozone standard is an exception to the pattern analyzed above: Of the four alternatives EPA examined, the *least* stringent one had the *highest* expected net benefits. Under a 3% discount rate, the less stringent alternative has net benefits of $3920 million, whereas the final standard has net benefits of $2530 million, and the more stringent standards have net benefits of -$1540 million and -$4850 million, respectively. Similarly, under a 7% discount rate the net benefits are higher for the less stringent alternative than for the final standard: $3330 million compared to $1650 million. Furthermore, the more stringent alternatives have even lower (and negative) net benefits of -$2920 million and -$7030 million, respectively. It follows that the same is true for the midpoint of the 3% and 7% discount rates, where the less stringent alternative has net benefits of $3625 million, as compared with $2090 million for the final standard, and -$2230 million and -$5940 million, respectively, for the two more stringent alternatives. Ozone is the only exception to the pattern observed for the other pollutants: There, the application of cost-benefit analysis would have led to a less stringent standard.

TABLE 5
COST-BENEFIT ANALYSIS OF OZONE 2008 STANDARDS
(MILLIONS OF 2006$)

	Less stringent alternative: 0.079 ppm		Final standard: 0.075 ppm		More stringent alternative: 0.07 ppm		More stringent alternative: 0.065 ppm	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Range of benefits	1740–11,400	1640–10,320	3460–18,000	3300–16,400	8520–32,400	8360–29,800	14,700–51,600	14,340–47,600
Benefits midpoint	*6570*	*5980*	*10,730*	*9850*	*20,460*	*19,080*	*33,150*	*30,970*
Range of costs	2400–2900	2400–2900	7600–8800	7600–8800	19,000–25,000	19,000–25,000	32,000–44,000	32,000–44,000
Costs midpoint	*2650*	*2650*	*8200*	*8200*	*22,000*	*22,000*	*38,000*	*38,000*
Net benefits midpoint	*3920*	*3330*	*2530*	*1650*	*-1540*	*-2920*	*-4850*	*-7030*
Midpoint of 3% and 7% net benefits	*3625*		*2090*		*-2230*		*-5940*	

V
Explaining the Paradox

What accounts for the inadequacy paradox? Why do health-based standards, which are universally believed to be more stringent than those that could be justified by cost-benefit analysis, in fact generally produce the opposite result? In this Part, we advance three explanations for this unexpected phenomenon. First, in contrast to cost-benefit analysis, the process for setting health-based standards does not take ancillary benefits into account. Second, because EPA must be generally aware that its standards impose costs on industry but cannot consider their actual magnitude, the behavioral phenomenon of uncertainty aversion indicates that the agency may overweight these costs. Third, industry groups will be in a better position to influence the agency by making arguments about the dislocations of stringent standards without the threat of having those arguments exposed to the scrutiny of notice-and-comment rulemaking.

A. Ancillary Benefits

The criteria documents on which EPA relies to set the NAAQS focus exclusively on the health benefits that accrue from reductions of the pollutant under review, and do not include an analysis of possible ancillary health benefits.[360] Moreover, in justifying its choice of standards, EPA neither relies on nor mentions ancillary benefits.[361] In contrast, in preparing the RIAs, on which it cannot rely in setting the standards since they necessarily involve cost-benefit analysis,[362] EPA does evaluate the ancillary benefits, as OMB requires it to do.[363]

Given this difference in the treatment of ancillary benefits, one plausible explanation for the divergence between the recommendations of cost-benefit analysis and those of a purely health-based inquiry is that a substantial portion of the quantified benefits for some NAAQS is generated by ancillary effects, rather than by reductions in the target pollutant itself. If the ancillary effects of more stringent regulation are systematically more likely to be positive rather than

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[360] *See, e.g.*, U.S. Envtl. Prot. Agency, Air Quality Criteria for Particulate Matter, EPA 600/P-99/002aF-bF (Oct. 2004); U.S. Envtl. Prot. Agency, Integrated Science Assessment for Oxides of Nitrogen – Health Criteria, EPA/600/R-08/071 (Jul. 2008). Even when EPA considers possible interactions among pollutants, it does not evaluate the ancillary benefits. *See* U.S. Envtl. Prot. Agency, Integrated Science Assessment for Sulfur Oxides – Health Criteria, EPA/600/R-08/047F at 3-8, 3-9, 3-28 (Sept. 2008).

[361] *See, e.g.*, Sulfur Dioxide 2010 Final Rule, *supra* note 165, at 35,525; Nitrogen Dioxide 2010 Final Rule, *supra* note 164, at 6478–83.

[362] *See supra* text accompanying notes 79–88.

[363] *See supra* text accompanying note 347.

negative, there would be a bias toward overly weak health-based standards, which do not account for ancillary effects, compared to cost-benefit analysis, which does.

As indicated above, the most important category of ancillary benefits generated by the NAAQS are particulate matter reductions. We have discussed the cases of nitrogen dioxide and sulfur dioxide, where the ancillary benefits were larger than the direct benefits.[364] But particulate matter reductions were also significant ancillary benefits for the lead and ozone standards, though in these cases they were not as large as the direct benefits.[365]

In principle, it might be rational to exclude the ancillary benefits of particulate matter reduction when setting the NAAQS for other pollutants if it was always the case that setting a more stringent particulate matter standard was the cheapest way to limit particulate matter emissions, and the particulate matter standard were set at the optimal level. For example, in such a situation it would not be sensible to increase the stringency of the sulfur dioxide standard, in order to achieve particulate matter reductions because, by hypothesis, all reductions maximizing the net benefit would have already been made. An objection to this assumption arises out of the structure of the NAAQS, which are uniform nationwide and apply to areas of both low and high population density and of low and high abatement costs. It is thus theoretically possible for an increase in the stringency of a nonparticulate matter NAAQS to be a less expensive means of reducing particulate matter exposure, depending on the particularities of abatement opportunities and population distribution.[366]

This objection may turn out not to have much practical significance.[367] A more pragmatic concern is that the particulate matter standard may not be set at the optimal level. This might occur because of lag in the development of updated standards, or might be the result of some public choice pathology. In either case, ancillary benefits

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364 *See supra* text accompanying notes 355–56 (for sulfur dioxide); text accompanying notes 352–53 (noting that the direct benefit of nitrogen dioxide standards were inestimable and that therefore the benefits reports were entirely ancillary).

365 *See* LEAD 2008 RIA, *supra* note 348, at ES-7 (noting that the benefits associated with NAAQS for lead include those of an ancillary nature); OZONE RIA, *supra* note 358, at 6-2, 6-3 (highlighting the substantial benefits ozone standards provide via particulate matter reductions).

366 If, for example, targeted sulfur dioxide or nitrogen dioxide emission reductions are mandated in an area that is highly populated, the benefits in terms of reductions in particulate matter may be more significant than those that would accrue from the direct regulation of particulate matter in a less targeted way.

367 In particular, if control of sulfur dioxide sources in nonattainment counties is unlikely to result in lower cost reduction of particulate matter, then this objection is more conceptual than practical.

could take the form of either temporary benefits, attributable to interim particulate matter reductions or a more persistent set of benefits, if the nonparticulate matter NAAQS were able to achieve improvements that were politically impossible under the particulate matter standard.

Why did the practice of failing to account for ancillary benefits develop? In 1970, when the CAA mandated setting NAAQS as the centerpiece of its regulatory approach,[368] there was not yet a developed understanding of the indirect consequences of regulation, either positive or negative. It is therefore not surprising that the original criteria documents did not discuss ancillary benefits.

The 1995 book *Risk versus Risk: Tradeoffs in Protecting Health and the Environment*, edited by John Graham and Jonathan Wiener, was the first major work to call attention to the importance of such consequences in regulatory decisionmaking. Although Graham and Wiener recognized that ancillary benefits could be important,[369] they focused largely on the negative consequences of regulation, or so-called "countervailing risks."[370] This emphasis on negative indirect effects was influential both in the academic literature and in regulatory decisionmaking.[371]

Christopher DeMuth and Judge Douglas Ginsburg, both former OIRA administrators,[372] provide the most recent defense of the claim that countervailing risks are more common than ancillary benefits.[373] DeMuth and Ginsburg argue that regulation is an intervention into a market "where individuals and organizations have durable interests and purposes of their own."[374] Thus, because regulation is necessarily intended to achieve a purpose that is not being accomplished privately, the "affected individuals and organizations will continue to pursue their independent purposes after [a] regulation is imposed" and "responses to regulation will tend to compromise regulatory purposes systematically rather than to compromise and amplify those purposes randomly or equally."[375]

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368 *See supra* text accompanying notes 75–77 (describing primary and secondary NAAQS).

369 John D. Graham & Jonathan Baert Wiener, *Confronting Risk Tradeoffs*, *in* RISK VERSUS RISK, *supra* note 346, at 2.

370 *Id.*

371 *See* REVESZ & LIVERMORE, *supra* note 14, at 60 (emphasizing the widespread influence of this analytical focus).

372 *See* Livermore & Revesz, *supra* note 26, at 1374 n.184 (listing the eleven OIRA directors to that point in time).

373 DeMuth & Ginsburg, *supra* note 304, at 888.

374 *Id*. at 887.

375 *Id*.

This argument focuses on one part of the regulatory dynamic: Actors burdened by a regulation might seek to bargain around it, thereby reducing, rather than amplifying, its effectiveness. Such actors will be likely to succeed if the resulting transaction costs are low. But that is not the whole story. In order to comply with a regulation, actors might need to change a production process. Such a change is likely to produce secondary consequences. In some cases, they will be negative: Banning the use of asbestos as a fire retardant reduces cancer risk, but substitute products may have risks of their own.[376] But in other cases, they will be positive. In order to meet the NAAQS for one pollutant, an electric utility may switch from burning coal to burning natural gas, thereby also reducing its emissions of other pollutants. It is precisely because of this dynamic that the NAAQS produce such significant ancillary benefits.[377]

OMB's Circular A-4 was a partial solution to the pathology of failing to properly account for ancillary benefits. Adopted in 2003, when Graham was the OIRA Administrator, it requires agencies to take into account both countervailing risks and ancillary benefits in performing cost-benefit analyses that accompany "significant" regulations.[378] But the logic of Circular A-4 has not influenced how EPA prepares criteria documents or relies on them to set the NAAQS.

But the seeds for requiring more comprehensive consideration of ancillary benefits have been planted. In a portion of its *American Trucking* opinion not reviewed by the Supreme Court, the D.C. Circuit stated that at least certain types of secondary effects must be considered by the agency when setting the NAAQS.[379] In that case, the court accepted the challengers' argument that EPA should have considered "the health benefits of tropospheric ozone as a shield from the harmful effects of the sun's ultraviolet rays."[380] The court noted that it "seems bizarre that a statute intended to improve human health would . . . lock the agency into looking at only one half of a substance's health effects in determining the maximum level for that substance."[381] Thus, the D.C. Circuit required the agency to account for the negative secondary consequences of regulation—the countervailing risks.

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376 *See* Corrosion Proof Fittings v. EPA, 947 F.2d 1201, 1221 (5th Cir. 1991) (noting that substitute products may have undesirable consequences).

377 REVESZ & LIVERMORE, *supra* note 14, at 63–64.

378 *See supra* text accompanying notes 22–25; *supra* text accompanying notes 338–39.

379 *See* Am. Trucking Ass'ns v. EPA, 175 F.3d 1027, 1051–52 (D.C. Cir. 1999) (rejecting EPA's argument that certain secondary effects should be disregarded), *rev'd on other grounds sub nom.* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001).

380 *Id.* at 1051.

381 *Id.* at 1052.

There is no defensible reason not to extend the D.C. Circuit's logic to the positive secondary consequences—ancillary benefits. Indeed, as DeMuth and Ginsburg have themselves noted, there are no "legal, political, or intellectual . . . impediments to treating ancillary benefits and countervailing risks equally in cost-benefit analysis."[382] But, although it may be perfectly rational, and perhaps even legally necessary, for the agency to consider ancillary benefits when engaged in the NAAQS inquiry, to date it has not done so. This failure helps to explain why a cost-benefit approach would lead to more stringent standards in the case of the sulfur dioxide and nitrogen oxide standards.

B. Uncertainty Aversion

Uncertainty aversion provides another possible explanation for why the NAAQS are suboptimally lax. The costs of complying with these standards cannot be formally considered in the NAAQS process, and are only subjected to rigorous scrutiny in the context of the regulatory impact analysis, which is not used to inform the agency's actual regulatory decision. But the EPA officials in charge of setting the NAAQS are nonetheless aware that the standards will impose costs on regulated industry. If EPA decisionmakers do indeed insulate their decision from information on costs (as they are legally obligated to do), but nonetheless are concerned about the negative social effects of overly stringent standards, uncertainty aversion—a behavioral tendency leading actors to prefer known risks over unknown risks—would bias the standards in a less stringent direction.[383] Such a result would run directly counter to the seeming intent of health-based standards, which is to minimize, rather than enlarge, the importance of costs in determining the final outcome.

Writing in 1921, Professor Frank Knight drew his famous distinction between risk and uncertainty. Risk exists for cases where outcomes can be characterized by means of a determinate probability distribution. Uncertainty, on the other hand, is not susceptible to measurement and therefore cannot be reduced to a probability distribution.[384] This distinction turns out to have behavioral consequences.

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[382] DeMuth & Ginsburg, *supra* note 304, at 888.

[383] *Cf.* Colin F. Camerer & Martin Weber, *Recent Developments in Modeling Preferences: Uncertainty and Ambiguity*, 5 J. RISK & UNCERTAINTY 325, 333–34 (1992) (highlighting a series of tests that demonstrate the widespread occurrence of "ambiguity aversion," or "intolerance of ambiguity").

[384] *See* FRANK H. KNIGHT, RISK, UNCERTAINTY AND PROFIT 197–232 (1921) (describing the characteristics of risk and uncertainty).

Risk aversion is a well-studied and theorized economic concept.[385] A person is risk averse if she prefers a guaranteed payment (say ten dollars) to probability of a payment with the same expected value (say twenty dollars based on a fair coin toss).[386] Risk aversion helps explain a great deal of important economic behavior, including the purchase of insurance and the premium demanded for investment in risky financial products.[387] A related concept, uncertainty aversion, refers to individuals' tendency to choose known quantities or options over those with which they are less familiar.[388] "[W]hen presented with a choice between a known and an unknown probability, individuals will prefer the known probability . . . ."[389] This result has been replicated in a variety of experimental settings.[390]

In setting the NAAQS, EPA purportedly relies only on information about the health consequences of pollution.[391] But even though it is not allowed to explicitly consider costs that the NAAQS would impose on regulated industry, agency personnel nonetheless likely worry about imposing excessive costs.[392] For example, in setting the NAAQS for lead in 1977, EPA acknowledged that certain types of facilities might be "severely strained both technically and economically in achieving emission reductions that may be required in implementing the proposed air quality standard."[393] In lengthening the averaging period from one month, as it had proposed, to three months, thereby weakening the standard, the agency admitted that the longer averaging period "lower[s] control costs, reduce[s] the probable number of sources which have to control, and decrease[s] the likelihood of plant closures."[394] In selecting the nonair contribution, it rejected a choice on the high part of the range, noting that it would

385 *See* Kenneth J. Arrow, *The Theory of Risk Aversion*, in ESSAYS IN THE THEORY OF RISK-BEARING 90 (Julius Margolis ed. 1971) ("From the time of Bernoulli on, it has been common to argue that (a) individuals tend to display aversion to the taking of risks and (b) that risk aversion in turn is an explanation for many observed phenomena in the economic world.").

386 *See* ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS § 5.2 (7th ed. 2009) (broadly outlining the concept of risk aversion).

387 *Id.*

388 Sarah B. Lawsky, *Modeling Uncertainty in Tax Law*, 65 STAN. L. REV. 241, 269–70 (2013) (discussing this phenomenon). For the pathbreaking discussion of uncertainty aversion and its relation to economic rationality, see Daniel Ellsberg, *Risk, Ambiguity, and the Savage Axioms*, 75 Q.J. ECON. 643, 650–53 (1961).

389 Lawsky, *supra* note 388, at 270.

390 *Id.* at 269–70 & nn. 84–89 (describing such experiments).

391 *See supra* notes 335–36 and accompanying text.

392 *See supra* notes 320–28 and accompanying text.

393 Lead 1977 Proposed Rule, *supra* note 103, at 63,082.

394 ECONOMIC IMPACT ASSESSMENT LEAD 1978, *supra* note 157, add. at 1.

produce an "exceptionally stringent standard,"[395] which presumably would be a bad thing only if it was too costly. More generally, as George Eads pointed out, the agency cannot afford to ignore the "enormous potential economic consequences" of its standards.[396]

The effects of uncertainty aversion could manifest themselves not only for aggregate costs, but also for how costs are distributed across society. A decisionmaker with an accurate picture of whether a stricter standard would cause industrial disruption and dislocation, cause layoffs, or create burdens that fall disproportionately on the poor might take that information into account when deciding the socially-desirable air quality level. But since the NAAQS process does not include information about these outcomes, an uncertainty-adverse decisionmaker would inflate the potential negative consequences of the selection of a stricter standard, in effect acting as though the potential for disruption, layoffs, or problematic distribution was higher than she really thought it was. Again, the result would be an inefficiently lax standard, compared to one in which the decisionmaker could rely on more complete information.

While it is possible that the prohibition on incorporating costs into the NAAQS decision process reduces their salience, as supporters of health-based standards assert,[397] it is also possible that costs cast a longer shadow over the proceedings than they would if they were quantified, as uncertainty aversion suggests. By hiding cost information from decisionmakers, it leaves them in the dark about a set of consequences that are very difficult, and ultimately undesirable, to entirely ignore. Rigorous analysis of potential costs, available to decisionmakers during the NAAQS process, could reduce the potential biasing effects of uncertainty aversion by casting light on what is otherwise a dark and ominous presence that silently influences the proceedings.

C. Role of Interest Groups

A third potential explanation for why the NAAQS appear to systematically underprotect the environment from the perspective of economic efficiency is that health-based standards increase the ability of powerful, well-organized interest groups—in this case regulated industry—to shape agency decisionmaking in their favor.

Under well-established doctrine, the notice-and-comment rulemaking process requires administrative agencies to reveal the

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395 Lead 1978 Final Rule, *supra* note 114, at 46,254.

396 Eads, *supra* note 318, at 228; *see also supra* text accompanying note 318.

397 *See supra* text accompanying notes 47–51.

basis of proposed rules in advance of a final decision.[398] The purpose of this requirement is to allow commenters to call the agency's evidence into question, submit their own evidence, or demonstrate flaws in an agency's reasoning process.[399] In essence, the notice-and-comment process creates the opportunity for a limited, paper cross-examination of the agency.

As discussed above,[400] health-based standards undermine agency reason giving by essentially requiring agencies to rely on considerations that may not legally appear in the record. Because the true bases for the agency's decisions are not in the record, they are not subject to even the limited paper cross-examination embodied in the notice-and-comment process. While commenters may submit information on whatever issues they deem important, they do not have the opportunity to specifically refute the actual basis for the agency's decision.

This situation may exacerbate public choice pathologies in administrative decisionmaking.[401] The public and transparent nature of the administrative process has been argued to reduce the risk that well-organized groups will be able to overpower diffuse interests.[402] While the administrative process cannot be expected to completely eliminate the advantages enjoyed by special interest groups, it may help reduce disparities between the powerful and the weak.[403]

Self-funded industry groups may have an easier time anticipating and responding to every potential factor that an agency might want to consider when arriving at a decision. But since the agency does not flag the cost information that it is (informally) relying on, smaller,

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398 *See* United States v. Nova Scotia Food Prods. Corp., 568 F.2d 240, 252–53 (2d Cir. 1977) (holding that without a statement of the general basis for the regulation, there is inadequate security against arbitrary decisionmaking).

399 *See id.* at 251–52.

400 *See supra* Part III.C (highlighting the inevitability of engaging in surreptitious consideration of costs).

401 Public choice theory predicts that diffuse and unorganized groups, like individuals that favor cleaner air, will have difficulty influencing government decisionmaking compared to well-organized, concentrated groups. *See*, *e.g.*, Daniel A. Farber, *Politics and Procedure in Environmental Law*, 8 J.L. ECON. & ORG. 59, 60 (1992) (explaining that "environmental groups will not organize effectively and that environmental statutes will not be passed"); Richard L. Revesz, *The Race to the Bottom and Federal Environmental Regulation: A Response to Critics*, 82 MINN. L. REV. 535, 542, 561 (1997) ("[I]t is difficult to explain, in public choice terms, why there would be any environmental regulation at all."); Jonathan Baert Wiener, *On the Political Economy of Global Environmental Regulation*, 87 GEO. L.J. 749, 752 (1999) ("[P]ublic choice theory predicts that the public's collective but diffuse general interest in a cleaner environment will be . . . systematically defeated in the political marketplace by industry's concentrated interest in avoiding costly regulation.").

402 *See* STEVEN P. CROLEY, REGULATION AND PUBLIC INTERESTS: THE POSSIBILITY OF GOOD REGULATORY GOVERNMENT 136, 140–41 (2008) (arguing that the possibility of judicial review of agency rulemaking "works to level the interest-group playing field").

403 *See id.*

cash-strapped organizations do not have the opportunity to fully use the notice-and-comment process to counter industry cost arguments. This problem would be exacerbated if general statements made by industry concerning costs were not docketed in the rulemaking record.

The failure to expressly consider costs may imbalance participation in the agency deliberative process in other ways as well. Agencies are required to respond to substantive comments,[404] even from groups that do not enjoy informal access to agency officials. This requirement ensures that serious comments receive some minimal level of consideration by the agency. However, because costs are not part of the health-based calculus, outsiders do not have the ability to demand even this limited level of attention.

Some groups may also misinterpret the agency's failure to openly acknowledge that it considers costs when setting the NAAQS as conclusive evidence that the agency in fact does not consider costs. If that is the case, they may fail to submit evidence that shows that costs are lower than the agency might expect. This tendency could be aggravated if groups believe (according to the conventional view) that consideration of costs will tend to reduce stringency, and do not wish to tacitly endorse agency departure from health-based criteria. On the other hand, industry groups are more sophisticated, and therefore are less likely to labor under the mistaken impression that the agency actually does not consider costs. They are not likely to be fearful of presenting their evidence that costs are too high.

Finally, the notice-and-comment process is also simply a conduit for all affected groups to provide information to the agency. Access to this process does not rely on expensive law firms or long-standing personal connections—it is a simple process open to everyone on (at least procedurally) equal terms. If the actual conversation on costs cannot take place through this process, it will be shunted into the world of *ex parte*, face-to-face conversations, where access is severely limited to the most aggressive, sophisticated, and well-funded interests.

For these reasons, and contrary to one of their most prominently stated rationales,[405] health-based standards may actually tilt agency decisionmaking toward the favored direction of well-organized interest groups. Rather than alleviating public choice pathologies in the administrative process, banning the public consideration of costs may actually make matters worse. If that is indeed the case, this phe-

[404] *See* United States v. Nova Scotia Food Prods. Corp., 568 F.2d 240, 253 (2d Cir. 1977) (holding that material comments and questions must be discussed and answered).

[405] *Supra* text accompanying notes 49–51.

nomenon might explain why the agency consistently chooses NAAQS levels that are inefficiently weak.

VI
Toward a New Approach

The preceding Parts presented two substantial problems with health-based standards. As a result of the stopping-point problem, EPA has no coherent basis for selecting a standard along a continuous spectrum of risk. If health considerations were truly the only cognizable factor, EPA should promulgate more stringent standards for each of the regulated pollutants and thereby protect a larger proportion of the population. In practice, other considerations are obviously playing a role in the agency's decision, but they cannot be mentioned in the administrative record or subjected to rigorous scrutiny.

Moreover, paradoxically, the resulting NAAQS are less stringent for all but one of the pollutants than the standards that would result from the use of cost-benefit analysis. These inefficiently lax standards may result from EPA's failure to account for the ancillary benefits of controlling a particular pollutant, from an aversion to uncertainty associated with imposing difficult-to-estimate costs, or from some other factor.

Part VI.A shows how these problems undermine the justifications that have traditionally been given for health-based standards. Section B argues that there is no defensible argument for setting the NAAQS at a level that is less stringent than would result from the application of cost-benefit analysis, and it urges a reinterpretation of *American Trucking* so that welfare-maximizing standards act as a regulatory floor. In Section C, we discuss potential arguments for using health-based considerations to push in the direction of more stringent standards than would result from the application of cost-benefit analysis.[406]

A. Failures of the Status Quo

Part I described four basic justifications for health-based standards that are advocated in the environmental law literature. Such standards have been defended as correcting for the underestimation of environmental benefits, reducing public choice imbalances between diffuse interests supporting environmental protection and the concentrated interest of regulated industry, forcing the development of more advanced pollution control technologies, and promoting a number

[406] Under an alternative but equivalent formulation, the health-based standards could provide the regulatory floor and cost-benefit analysis could be the trump.

nonwelfarist goals. Such goals include recognizing a right to be free from pollution, highlighting moral qualms about trading off health against other goods, and embracing the expressive value of standards meant to protect health—no matter the cost.

Each of these justifications is undermined by the stopping-point problem and the inadequacy paradox. As discussed above, by weakening the connection between the reasons given for a regulation and the actual grounds used by regulators to make the decision, the stopping-point problem reduces the transparency of regulatory proceedings and interferes with administrative law institutions—such as judicial review—that are meant to help bolster the ability of less powerful groups to protect their interests.[407]

The inadequacy paradox also undermines the argument that health-based standards are necessary to correct for the undervaluation of environmental benefits relative to costs. If this problem in fact exists, our experience with the NAAQS reveals that health-based standards have exacerbated rather than ameliorated it.

Nor does "technology-forcing" provide a better justification for health-based standards.[408] Technology is not one of the cognizable criteria for determining health-based standards. There may or may not be entirely adequate technology to meet whatever standard the agency happens to choose, but the agency does not currently have procedures to ascertain that important fact. If there is some social benefit associated with technological innovation, it might be perfectly reasonable for an agency to force the introduction of new technology by selecting a more stringent standard than it otherwise would choose. But such a decision is not allowed under the strictures of health-based standards. Moreover, if health-based standards were systematically more stringent than standards derived from the use of cost-benefit analysis, they would produce additional incentives for technological innovation. But, as a result of the inadequacy paradox, the opposite is generally true.

The nonwelfarist explanations for health-based standards perhaps stand up the best in light of the stopping-point problem. If avoiding the balancing of environmental harm against other social goods is the actual purpose of health-based standards, then the stopping-point problem does not directly undermine that goal. But whatever benefit is accomplished in terms of vindicating rights, expressing support for a clean environment, or avoiding commoditization comes at a price.

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[407] *See supra* Part III.D (noting that the current status quo undermines the objectives and benefits of reason-giving).

[408] For discussion of the "technology-forcing" argument, see *supra* text accompanying notes 52–55.

Namely, a regulatory decision reached without balancing of costs is necessarily poorly justified and may be disconnected from any otherwise-desirable social goal.

In contrast, the inadequacy paradox poses greater problems for nonwelfarist justifications for health-based standards. If the use of an efficiency approach to standard setting would generate a more protective level of pollution control, it would seem odd to invoke an environmental right to justify reducing the level of protection that is offered by the regulatory regime. Likewise, if health-based standards express a national commitment to a clean and healthy environment, it would be odd if that commitment resulted in environmental standards that were inefficiently weak. Even the anti-commoditization position becomes problematic in light of the inadequacy paradox. Presumably, the worry about commoditization is that comparing health to other social goods (like reduced consumption) devalues the importance of health and underemphasizes the moral importance of avoiding harm to persons.[409] It would therefore be counterintuitive that the anti-commoditization position would remain attractive, even if it resulted in greater environmental harms.[410]

B. Cost-Benefit Analysis as a Regulatory Floor

Health-based standards are likely to remain a persistent feature of U.S. environmental law, particularly given the current congressional paralysis. But EPA does not need to continue promulgating NAAQS in a way that results in levels of protection that are less stringent than those that would result from the application of cost-benefit analysis. We argue, instead, that EPA has the discretion to use cost-benefit analysis as a regulatory floor and that it should exercise this discretion.

At first glance, this approach might appear to be precluded by the Supreme Court's decision in *American Trucking*. That case, however, was litigated in a context in which all the parties on both sides argued that the application of cost-benefit analysis would result in less stringent standards and in which the Court accepted this characterization.[411] As a result, the precise holding of the case should be characterized as follows: EPA may not take costs into account when to

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409 *See supra* text accompanying notes 56–60.

410 Some types of distributional criteria might call for standards that are *less* stringent than the welfare-maximizing standards, for example when the costs of meeting the standards were borne by poor individuals but the standards mostly benefited wealthier people.

411 *See supra* text accompanying notes 82–88 (recounting the holding in *American Trucking*).

do so would weaken the standards the agency derives from public health considerations alone. Any broader language that might be interpreted as precluding the consideration of costs when the result would be *more* stringent standards should be regarded as dicta. Therefore, it should be open to relitigation.[412]

Not surprisingly, the party briefs filed in support of American Trucking Associations argued in favor of cost-benefit analysis.[413] The briefs by named parties in support of EPA took the opposite position.[414] Similarly, the amicus briefs submitted on both sides clearly

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[412] *See* Kirtsaeng v. John Wiley & Sons, 133 S. Ct. 1351, 1368 (2013) (stating that the Court is "not necessarily bound by dicta should more complete argument demonstrate that the dicta is not correct"); Humphrey's Ex'r v. United States, 295 U.S. 602, 627–28 (1935) (noting that dicta may be followed by courts if "sufficiently persuasive," but are otherwise not controlling).

[413] *See* Brief for Cross-Petitioners at 28–30, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1014021; Reply Brief for Cross-Petitioners at 6, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1509625; Brief of States of Ohio, Michigan & West Virginia in Support of Cross-Petitioners at 16, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1014290; Reply Brief of States of Ohio, Michigan & West Virginia in Support of Cross-Petitioners at 9, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1506497; Reply Brief at 11–12, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1506502; Brief of Respondents American Trucking Ass'ns et al., at 22–23, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1299498; Brief for Respondents Appalachian Power Co. et al., Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1299500; Brief for Respondents Appalachian Power Co. et al., in Support of Petitioners at 36–37, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1426), 2000 WL 1010284; Brief of Respondent States of Ohio, Michigan & West Virginia at 10, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1299492. One brief did not argue for cost-benefit analysis, arguing instead that EPA did not sufficiently "explain the 'limiting standard' that guided its exercise of public health risk management judgment." Brief for Respondents Appalachian Power Co. et al., at 35, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1299500.

[414] *See* Brief for Petitioners at 50, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1010083; Reply Brief for Petitioners at 9 n.12, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1479928; Brief of Respondent Am. Lung Ass'n in Support of Petitioner at 26, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1010280; Reply Brief of Respondent Am. Lung Ass'n in Support of Petitioners at 2, 7–8, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1509907; Brief of Respondents Citizens for Balanced Transp. et al. at 45, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1300433; Brief for Federal Respondents at 50, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1280341; Brief for Respondents Massachusetts & New Jersey in Support of Petitioners at 29–30, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1010282; Reply Brief for Respondents Massachusetts & New Jersey in Support of Petitioners at 2–3, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1479934; Brief of Respondents Massachusetts & New Jersey at 50, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1257), 2000 WL 1300435; Brief of Cross-Respondent Am. Lung Ass'n at 50, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1300424.

reflected the universally accepted view that a health-based standard would result in more stringent environmental regulations than ones produced by the consideration of costs. Twenty-three amicus briefs were filed in support of the American Trucking Associations, fourteen of which argued for a cost-benefit analysis requirement.[415] Six of the

[415] For those fourteen, see Brief Amici Curiae of AEI-Brookings Joint Center for Regulatory Studies et al., in Support of Cross-Petitioners at 11, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015407; Brief of *Amicus Curiae* of Alcan Aluminum Corp. in Support of Cross-Petitioners at 1–2, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1299546; Motion for Leave to File Brief *Amicus Curiae* and Brief *Amicus Curiae* for the Am. Boiler Mfrs. Ass'n Supporting Petitioners at 13–14, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015424; Brief of the Gen. Elec. Co. as Amicus Curiae in Support of Cross-Petitioners at 21–22, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1010086; Brief Amici Curiae of Intel Corp. et al. at 24, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298969; Brief of Amicus Curiae Mercatus Ctr. in Support of Respondents at 4, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298998; Brief of Amicus Curiae Mercatus Ctr. in Support of Cross-Petitioner at 19–20, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015565; Motion for Leave to File Brief Amicus Curiae and Brief Amicus Curiae of Pac. Legal Found. & Cal. Chamber of Commerce in Support of Respondents Am. Trucking Ass'ns et al. at 19–20, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1299019; Brief of Pac. Legal Found. & Cal. Chamber of Commerce in Support of Cross-Petitioners at 15, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015441; Brief for Sens. James M. Inhofe et al. as Amici Curiae in Support of Cross-Petitioners at 9–11, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015705; Brief of Amici Curiae Sen. Orrin Hatch & Rep. Tom Bliley in Support of Respondents at 30, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1299009; Brief of Senator Orrin Hatch & Representative Tom Bliley in Support of Cross-Petitioners at 4, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015720; Brief of *Amicus Curiae* Va. in Support of Respondents at 15, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1341270; Brief *Amici Curiae* of Wash. Legal Found. & Allied Educ. Found. in Support of Cross-Petitioners, Am. Trucking Ass'ns v. Browner, 530 U.S. 1202 (2000) (No. 99-1426), 2000 WL 1015745. Eight briefs focused solely on the nondelegation issue. *See Amicus Curiae* Brief of Am. Crop Prot. Ass'n et al. in Support of Respondents at 31, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298842; Brief for Am. Inst. of Certified Pub. Accountants et al., as Amicus Curiae in Support of Respondents, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298911; Brief of Amici Curiae Ass'n of Am. Physicians & Surgeons & Ctr. for Individual Freedom in Support of Respondents, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298936; Brief of *Amicus Curiae* Gen. Elec. Co. in Support of Respondents, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298958; Brief *Amici Curiae* of the Institute for Justice & the Cato Inst. in Support of Respondents, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298963; Brief Amicus Curiae of Lincoln Inst. for Research & Educ. et al. in Support of Respondent, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298976; Brief of Mfrs. Alliance et al. as *Amici Curiae* in Support of Respondents, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1298986; Brief *Amicus Curiae* of People for the U.S.A. & Alliance for Am. in Support of Respondents, Browner v. Am. Trucking Ass'ns, 529 U.S. 1129 (2000) (No. 99-1257), 2000 WL 1469333.

amicus briefs that argued in favor of a cost-benefit analysis requirement were submitted on behalf of industry groups, while the rest were submitted on behalf of states or anti-regulatory think tanks. Seven amicus briefs were filed in support of EPA's position that costs could not be taken into account in setting the standards.[416]

No industrial group or trade association argued that cost-benefit analysis should be prohibited, and no environmental group argued it should be allowed. These groups would not have taken their respective positions had they not believed that cost-benefit analysis would lead to less stringent levels of regulation. While industry groups may have some degree of ideological affinity for cost-benefit analysis, and environmental groups may have ideological antagonism, these actors are results oriented: If they held the opposite set of beliefs about the relationship between cost-benefit analysis and stringency, their positions would be reversed. The fact that arguments about the legal permissibility of cost-benefit analysis so closely tracked the interest groups' political goals is a very clear sign of the broad acceptance of the view that health-based standards are associated with high levels of regulatory stringency and that the consideration of costs is associated with the weakening of health-based standards.

Moreover, the Court itself assumed that the consideration of costs would lead to less stringent standards. Justice Scalia's majority opinion notes that the "[cost of implementation is] so full of potential for canceling the conclusions drawn from direct health effects that it would have been expressly mentioned in §§ 108 and 109 had Congress meant it to be considered."[417] Thus, Justice Scalia believed that the consideration of costs in setting the NAAQS would undermine the protection of public health: By "canceling the conclusions drawn from direct health effects," the consideration of "cost of implementation"

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[416] *See* Brief of California & Connecticut et al. as Amici Curiae in Support of Cross-Respondents at 30, Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1426), 2000 WL 1299559; Brief of The Clean Air Trust & Sen. Robert Stafford as Amici Curiae in Support of Cross-Respondents at 29, Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1426), 2000 WL 1299549; Brief of Envtl. Def. et al. as Amici Curiae on Behalf of Cross-Respondents at 23–25, Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1426), 2000 WL 1299554; Brief of New York & California et al. as Amici Curiae in Support of Petitioners at 11–12, 14, Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1257), 2000 WL 1014424; Brief of North Carolina as Amicus Curiae in Support of Cross-Respondents at 17, Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1426), 2000 WL 1299561; Brief of United States Pub. Interest Research Group Edu. Fund as Amici Curiae in Support of Cross-Respondents at 3, Whitman v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1426), 2000 WL 1299562; Brief of Envtl. Defense et al. as Amici Curiae Supporting Petitioners, Browner v. Am. Trucking Ass'ns, 531 U.S. 457 (2001) (No. 99-1426), 2000 WL 1014316.

[417] Whitman v. Am. Trucking, 531 U.S. 457, 469 (2001).

must be pushing the standard in the direction of less health. And Justice Stevens, in his dissent in *Entergy Corp. v. Riverkeeper*, similarly described the Court's approach to this matter in *American Trucking*, where he had joined the relevant part of the opinion: "Further motivating the Court in *American Trucking* was the fact that incorporating implementation costs into the Agency's calculus risked countermanding Congress' [sic] decision to protect public health."[418] Like Justice Scalia, Justice Stevens assumes a tradeoff between considering costs and protecting public health.

A similar conclusion flows from Justice Breyer's review of the legislative history in his *American Trucking* concurrence, which relied heavily on a statement by Senator Muskie, the primary sponsor of the Clean Air Act of 1970. When he introduced the bill, Senator Muskie indicated that

> Congress' [sic] primary responsibility in drafting the Act was not "to be limited by what is or appears to be technologically or economically feasible," but "to establish what the public interest requires to protect the health of persons," even if that means that "*industries will be asked to do what seems to be impossible at the present time.*"[419]

But, of course, "what seems to be impossible" at a time when a cost-benefit analysis is conducted would be extremely costly and therefore would lead to an unattractive cost-benefit calculus. The fact that a cost-benefit analysis would lead to more stringent standards was not a possibility that Senator Muskie—or Justice Breyer—had contemplated.

As a result of the way in which the arguments were presented to the Court and the way in which the Court dealt with these arguments, the holding of *American Trucking* should be characterized as precluding the consideration of costs only in instances when doing so would lead to less stringent standards than the ones determined solely through reliance on public health considerations. The holding should not be extended to the opposite situation, which is the focus of this Article, in which the consideration of costs would lead to more stringent standards. With respect to this situation, the statute should be characterized as being silent.

Typically, in the case of statutory silence, an agency's interpretation of the statute that Congress has empowered it to administer is

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[418] Entergy Corp. v. Riverkeeper, Inc. 556 U.S. 208, 239 (2009) (Stevens, J., dissenting).

[419] *Am. Trucking*, 531 U.S. at 491 (Breyer, J., concurring in part and concurring in the judgment) (quoting Senator Muskie).

entitled to *Chevron* deference.[420] In such instances, the agency's interpretation would generally not be regarded as inconsistent with the clear intent of Congress under *Chevron* Step 1 and would therefore be upheld by the courts under *Chevron* Step 2 if "reasonable."[421] *American Trucking* should be seen as an exception to this general principle. An approach that interprets all congressional silence to prohibit cost consideration collapses three categories into two. First, Congress can require the consideration of costs. Second, Congress can prohibit the consideration of costs. And third, Congress can be silent because it intends to delegate that decision to the agency empowered to administer the statute. In the first and second cases, there is no room for agency discretion; in the third there is and the agency's decision would be accorded *Chevron* deference by a reviewing court. In *American Trucking*, the Court conflated the second and third categories.

The Court departed from this approach in *Entergy*. Also in an opinion by Justice Scalia, it held that a statute's silence on the use of cost-benefit analysis did not display an intention to forbid its use.[422] Thus, the *American Trucking* treatment of silence with respect to the consideration of costs appears to be limited to the statute and context of that case.

We argue here, consistent with traditional norms of statutory construction dealing with statutory silence, as embodied in *Chevron* and with the Court's specific application of this principle as applied to cost-benefit analysis in *Entergy*, that a proper interpretation of *American Trucking* is less sweeping with respect to the third category than the Court's language in that case might suggest at first glance. The consideration of costs in the face of congressional silence should be prohibited only in cases in which it would lead to compromising the stringency of the health-based standards, which was the situation the Court focused on in *American Trucking*, not where it would lead to strengthening them.

Under Executive Order 12,866, administrative agencies are required to justify regulatory decisions through the application of cost-benefit analysis except where such consideration is "prohibited by law."[423] As a result, under the interpretation of *American Trucking*

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[420] *See* Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc., 467 U.S. 837, 842–44 (1984) (establishing the doctrine of *Chevron* deference); Thomas W. Merrill & Kristin E. Hickman, *Chevron's Domain*, 89 GEO. L.J. 833, 833 (2001) (summarizing the *Chevron* doctrine).

[421] *Chevron*, 467 U.S. at 842–43.

[422] *See Entergy*, 556 U.S. at 222 (rejecting the argument that the absence of express statutory authorization implies prohibition).

[423] Exec. Order No. 12,866, *supra* note 21, § 6(C).

that this Article advocates, EPA would be required to first determine, as currently, what NAAQS is appropriate on the basis of public health considerations alone. Then, it would look at the cost-benefit analysis, which is already prepared in the RIAs during the regulatory proceedings.[424] It would then pick the more stringent of the standards justified by heath-based inquiry and cost-benefit analysis. In the former case, EPA would not modify its health-based approach, pursuant to the *American Trucking* holding. But in the latter case, it would be required by the Executive Order to make the standard more stringent. As the analysis of Part IV shows, this approach would lead to more stringent NAAQS for lead, particulates, nitrogen dioxide, and sulfur dioxide. And it would not compromise the stringency of any of the existing standards.

We assume that in order for EPA to embark on this journey, it would need to get the authorization of the Department of Justice's Environment and Natural Resources Division, which litigates on behalf of EPA in the federal courts. And, because a lower court reviewing EPA's new approach might consider itself compelled to follow *American Trucking*, the matter might ultimately need to be resolved by the Supreme Court. As a result, it would be wise for the Solicitor General to agree to the plan as well.

The approach that we advocate would eliminate the inadequacy paradox in all cases because each NAAQS would be at least as stringent as the welfare-maximizing standard. And it would significantly mitigate the stopping-point problem by creating a default standard that is determined by a weighing of competing considerations.

C. Health-Based Standards Revisited

The prior section established that EPA has the discretion to ensure that the NAAQS are not less stringent than the welfare-maximizing standards that would be determined through the application of cost-benefit analysis. To promote economic efficiency and adhere to governing Executive Orders, EPA ought to use that discretion to select more stringent standards when they are warranted on cost-benefit grounds. But the question remains whether there is any justification for standards that are more stringent than the welfare-maximizing standards.

As a matter of law, the answer is yes. The Supreme Court was extremely clear that cost considerations could not be used to reduce the stringency of the NAAQS. So long as *American Trucking* remains

[424] *See supra* text accompanying notes 22–25, 335–36 (discussing the use of cost-benefit analysis in RIAs).

good law, in cases where EPA's health-based analysis resulted in a standard that was more stringent than that recommended by cost-benefit analysis, the health-based standards would trump, as it did in the case of ozone.[425]

In Part I.C, we examined possible justifications for health-based standards, which are severely undermined by the stopping-point problem and the inadequacy paradox. But, assuming that our recommendations from the previous section were followed, and the agency avoided the inadequacy paradox by adopting more stringent standards when recommended by cost-benefit analysis, some of those justifications may remain persuasive. In particular, arguments that relied on nonwelfarist considerations such as rights or expressive value to undergird health-based standards would retain power when used to favor stronger environmental protections.

Unless the agency can take some countervailing or balancing considerations into account when setting health-based standards, however, the stopping-point problem will continue to arise. Assume, for example, that the CAA is meant to express a commitment to environmental health and that this expressive goal justifies standards that are more stringent than would be economically efficient. When an additional increment of stringency would continue to reduce risk, and further express a commitment to a clean environment, what justification would the agency have in stopping? If the agency cannot balance the communicative value of greater stringency against any other social consideration, it is impossible to arrive at a stopping point.

Environmental rights and environmental justice considerations present similar problems. Imagine an environmental right such that no person may face more than a 1 in 10,000 annual mortality risk from exposure to all air pollutants.[426] And imagine that this hypothetical right also includes a sufficiently precise account of how scientific uncertainty and population heterogeneity should be taken into account. If this were the case, it would be possible to avoid the stopping-point problem when setting an environmental standard to vindicate that right: The agency would stop at 1 in 10,000 (accounting for scientific uncertainty and population heterogeneity). But although there is no obvious reason why such a clear right could not be *defined* by the agency, we are skeptical that it could be *justified* without considering countervailing factors. Why 1 in 10,000 and not 1 in 9000 or 20,000? It would also be an odd kind of right if it required the expen-

425 *See supra* Part IV.B.5.

426 *See* Revesz, *supra* note 401, at 544 ("A minimum level of health ought to count as a basic human right . . . .").

diture of infinite resources to reach 1 in 10,000 for one person, but not even a single dollar to eliminate a 1 in 100,000 risk for another.

The only way for the agency to avoid the stopping-point problem is to acknowledge and weigh, either quantitatively or qualitatively, social factors other than the goal that is being promoted by the standard. The agency could, in theory, do so after the regulatory impact analysis was complete: An explicit decision could be made about whether and how much to depart from the efficient level of stringency in order to vindicate environmental rights, for example, or to express a commitment to environmental values. This balancing of social priorities, even if done in a nonquantitative manner, would avoid the stopping-point problem.

But this solution is precluded under existing law. As we argued earlier, however, the stopping-point problem is not unacceptable as a matter of constitutional law.[427] In a complex modern society, broad delegation of authority to agencies is a necessary feature of the administrative state. This need is especially compelling in the environmental area, where decisions turn on complex scientific and economic questions. Congress made a valid attempt to structure the agency's decisionmaking in this difficult area. So long as the inquiry that Congress has given the agency allows meaningful public participation and judicial review, and is neither paralyzing nor so open-ended as to amount to a complete abdication on the part of Congress, the statute should pass constitutional muster. That the agency must exercise some policy discretion while engaging in an inquiry that is not perfectly structured to inform the exercise of that discretion is not sufficient reason to find the statute unconstitutional.

The agency, then, will need to continue to make unstructured "public health policy judgments"[428] on normative questions when setting health-based standards, at least for the time being. While the agency cannot explicitly ensure that the efficiency costs associated with health-based trumps are justified by sufficiently strong nonwelfarist considerations, it should try to do so. To the extent that agency officials engage in informal balancing between efficiency considerations and some set of nonwelfarist concerns, there is hope that health-based departures from cost-benefit analysis will fall within a range of outcomes that can plausibly be justified. But, because this balancing inquiry cannot be disclosed, we will never know.

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[427] *See supra* text accompanying notes 314–16.

[428] *See supra* text accompanying notes 170–75 (surveying rules that have led to the stopping-point problem).

Conclusion

In this Article, we have shown that the centerpiece of the CAA—the National Ambient Air Quality Standard program—exhibits two serious pathologies. The first is the stopping-point problem. In setting such standards, EPA cannot provide a coherent explanation for why it did not pick a more stringent alternative, given that public health considerations are the only legally cognizable factors that it can take into account under the current interpretation of the law. This problem, which is most clear in the case of nonthreshold pollutants, manifests itself for threshold pollutants as well.

Moreover, we debunk in this Article a widely held assumption that health-based standards like the NAAQS would lead to more stringent standards than would the application of cost-benefit analysis. We show that, for the NAAQS, the reality has generally been the opposite, giving rise to the inadequacy paradox.

The universally accepted consensus is that the Supreme Court's decision in *American Trucking* stands in the way of even a partial solution to these problems by precluding the consideration of costs in setting the NAAQS. We argue, in contrast, that a proper understanding of this decision would permit the use of cost-benefit analysis when it would lead to more stringent standards than those derived from health-based considerations alone. This approach solves the inadequacy paradox.

As a result, the NAAQS would never be less stringent than the welfare-maximizing standards. But unless there are some instances in which these standards could be more stringent, we would have collapsed the health-based inquiry into a cost-benefit inquiry in a manner that would in fact be inconsistent with *American Trucking.* We accept instead that health-based considerations could still act as trumps pushing in the direction of additional stringency and argue that EPA should, in its "public health policy judgments" analysis, attempt to balance nonwelfarist benefits of additional stringency with efficiency costs.