J O I N T   C E N T E R
AEI-BROOKINGS JOINT CENTER FOR REGULATORY STUDIES

The Economic Significance of "Insignificant" Rules

Robert Hahn and Caroline Cecot*

Related Publication 06-06
Original: August 2006
Revised: February 2007

*Mr. Hahn is co-founder and executive director of the AEI-Brookings Joint Center and a scholar at AEI. Ms. Cecot is a research assistant at the AEI-Brookings Joint Center. The authors would like to thank David Burk, Robert Litan, Eric Posner, Al McGartland, Cass Sunstein, Scott Wallsten, Molly Wells and Jonathan Wiener for helpful comments. They are also grateful to Randy McDonald and Larry Sorrels of the Environmental Protection Agency for answering detailed questions about the proposed rule. The views expressed in this paper reflect those of the authors and do not necessarily reflect those of the institutions with which they are affiliated.

Executive Summary

We know relatively little about the economic impacts of “insignificant” rules because they are not typically analyzed. Yet, these rules could be important. We provide an economic analysis of one proposed rule to control hazardous air pollutants which is not considered to be economically significant. This rule is of particular interest because it is one of the first in a long series of rules that Environmental Protection Agency (EPA) will consider for limiting hazardous air pollutant emissions. Our analysis suggests that the proposed controls that EPA has considered are not likely to pass a benefit-cost test. We recommend that an agency base its decision to allocate additional resources to benefit-cost analysis on the expected value of the improved information. In addition, agencies should consider applying a rule of thumb that would specify a threshold level of risk reduction that needs to be achieved before some kinds of regulation are considered.

Key Words: Benefit-Cost Analysis, Regulation, Risk Analysis, Environmental Economics

The Economic Significance of "Insignificant" Rules

Robert Hahn and Caroline Cecot

1. Introduction

Scholars know relatively little about the economic impacts of "minor" or "insignificant" rules because they are not typically analyzed.[1] Each of these rules costs less than $100 million annually, but at least some of them could be important. To illustrate, we provide an economic analysis of one proposed rule to control hazardous air pollutants that is not considered to be economically significant.

Part of the U.S. Clean Air Act deals with the regulation of hazardous air pollutants. The laws governing the regulation of these pollutants require the application of maximum available control technology standards. In addition, the Act requires that the U.S. Environmental Protection Agency (EPA) address the "residual risk" that remains after the implementation of these standards. EPA's task is two-fold: to provide "an ample margin of safety to protect public health" and to prevent, considering costs and other factors, an adverse environmental effect.

To ensure an ample margin of safety, EPA has recently proposed two ways of addressing residual risk for the synthetic organic chemical manufacturing industry (EPA, 2006). The first is to maintain the status quo and the second is to introduce three additional control measures. EPA's proposal is not considered to be economically significant, one which, as defined by Executive Order 12866, could have an annual effect on the economy of $100 million or more. This means that the preparation of a full regulatory impact analysis that weighs the costs and benefits of the proposed rule was not required.

If the current maximum available control technology standards are effective at reducing the large risks, there may only be very small remaining risk reductions that can be achieved with residual risk rules, and their likely costs may outweigh their likely

[1] We use the phrases "minor" and "insignificant" interchangeably.

benefits.[2] Indeed, some earlier scholarship questions whether the initial efforts to regulate hazardous air pollutants under the Clean Air Act were likely to be worth the cost (Portney, 1990). A closer look at one of these rules could illustrate their potentially excessive costs and thereby help inform future legislative and regulatory decisions.

The potential cumulative effect of minor rules could be important. In 2005, the Office of Information and Regulatory Affairs (OIRA)—which is the office within the U.S. Office of Management and Budget (OMB) responsible for reviewing rules—reviewed over 528 minor rules, of which 209 were final rules (RegInfo.gov). The rules reviewed by OIRA probably represent only a small percentage of the total number of minor rules written and passed by agencies each year.[3] Even if each rule has a small impact, say in the tens of millions of dollars, such rules may be important in the aggregate. Furthermore, if these rules are important from an economic and social standpoint, it raises at least the possibility that they deserve closer scrutiny. On the other hand, some scholars have pointed out that doing more economic analysis need not result in better outcomes (Lave, 1996). This paper will address this issue, providing what we believe is the most sensible approach to the analysis of minor rules.

One attempt to examine the relative impact of major and minor rules was done by OMB (2004) for a select group of agencies that were more likely to estimate costs and benefits for minor rules.[4] OMB found that a high percentage of the costs were due to the major rules, which might imply that the cumulative impact of minor rules is small. OMB's analysis excluded EPA, the agency whose major rules were responsible for a majority of the costs and benefits generated by U.S. federal regulation in the last ten years (OMB, 2006). By closely examining an EPA minor rule, and providing one of the first benefit-cost analyses of such a rule, this research note illustrates that EPA minor rules may have more substantial effects than previously thought. .

---

[2] EPA is required to assess the residual risk remaining and promulgate standards if the excess individual cancer risk is higher than one in one million.

[3] There is no one database of all minor rules. No agency is required to record all minor rules in their agenda. OIRA reviews only the most important minor rules, those that are "significant" (OMB, 2001). This information was confirmed in a telephone conversation between Caroline Cecot and John C. Thomas, Executive Director of the Regulatory Information Service Center, on August 9th, 2006.

[4] OMB (2004) looked at three agencies: the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), and the National Highway Traffic Safety Administration (NHTSA). Stikkers (2004) also includes minor rules in his study of the process of rulemaking, concluding that they attract on average an order of magnitude fewer comments than major rules.

We have three objectives: first, to provide a brief economic analysis of EPA's proposal; second, to consider how both analysis of and regulation by minor rules could be improved; and third, to consider the issue of whether "insignificant" rules are worth studying on a larger scale.

We use estimates presented by EPA in the *Federal Register* and rely on some simplifying assumptions regarding benefits and costs. Our purpose here is not to provide a definitive benefit-cost analysis of EPA's proposed rule, but rather to illustrate how the agency's analysis of such a minor rule could be improved. We conclude that with a little more effort, the analysis of the rule we examine could be improved significantly, and we illustrate how that might be done. Furthermore, we argue that "insignificant" rules are in general worth exploring in more detail to examine their broader economic implications.

Section 2 of this paper presents an economic analysis of the two regulatory options proposed by EPA to regulate hazardous air pollutants from synthetic organic chemical manufacturing, as well as an analysis of each control measure separately. Section 3 analyzes EPA's actions, providing recommendations for similar rules that do not rise above the significance threshold. Section 4 outlines a strategy for analyzing insignificant rules and also suggests an alternative method for screening regulations that would rely on a de minimis threshold for risk reductions. Section 5 presents our conclusions and suggests areas for future research.

2. Estimating Benefits and Costs of EPA's Proposal

In a proposal issued in 2006, EPA considered two options for regulating hazardous air pollutants from the synthetic organic chemical manufacturing industry. Option 1 proposed imposing no additional controls. We take this as the baseline and assume that the net benefits of this strategy are zero. Option 2 included three control measures. These measures involved controlling emissions from storage tanks, controlling emissions from process vents, and decreasing the percentage of leaking valves.

EPA's residual risk assessment found that the maximum individual lifetime cancer risk exceeds one in one million in many individual manufacturing plants, but is at most 100 in one million for all plants. EPA did not expect any significant non-cancer health effects. The annual cancer incidence for the entire exposed population was estimated at 0.1 cases per year. EPA also found that health threats by acute inhalation exposure are "very unlikely." EPA estimated that Option 2 would reduce annual cancer incidence by 0.01, or would prevent one cancer case every 100 years for the exposed population by decreasing the tons of hazardous air pollutant emissions.

Table 1 provides information on annualized costs, annualized benefits, and net benefits.[5] In addition, it provides estimates of costs, benefits, and net benefits per ton of volatile organic compounds (VOC) removed, of which the hazardous air pollutants are a subset.[6] To conduct our benefit-cost analysis, we use EPA's estimates from a number of documents and make many critical assumptions.[7] The results for EPA's proposal are given in Table 1 under the final column labeled "Option 2." This column also corresponds to the sum of the annualized costs and benefits of the three control measures where appropriate.

We consider three different discount rates—3 percent, 5 percent, and 7 percent.[8] There are two sets of figures under each discount rate scenario. First, there are total annual costs, benefits, and net benefits (which are computed by subtracting costs from benefits). Second, there are annual costs, benefits, and net benefits on a per ton basis. For all three discount rates, the net benefits per ton are negative, which suggests that Option 2 is not likely to pass a benefit-cost test under the modeling assumptions and data used here.

EPA presented Option 2 in terms of implementing all three control measures at the same time. In Table 1, we also consider the costs and benefits of the control measures individually. We do this because it allows us to compare the economic impacts of these measures to each other and to consider the effect of using combinations of these control measures.

[5] For simplicity, numbers are generally rounded to one significant digit. All dollar numbers are converted to 2003 dollars using the Consumer Price Index from the Bureau of Labor Statistics to adjust for inflation.
[6] Considering only the cancer risk reductions due to the HAP reductions, the cost per cancer case prevented of Option 2 is more than $1.3 billion. This calculation is misleading, however, since it does not consider the additional ozone reduction benefits due to the reduction of total volatile organic compounds.
[7] For details on these assumptions, as well as how we conducted our sensitivity analysis, please see the Appendix.
[8] EPA cost numbers were reported using a 7 percent discount rate. We use 3 percent and 5 percent as well to explore how the results might change.

From Table 1, we see that controlling emissions from storage tanks has a positive net benefit per ton using the high benefit value, but a negative net benefit (i.e., net cost) using the low benefit value. The other two emission controls have net costs under both scenarios. We conclude that two of the control measures are not likely to pass a benefit-cost test, but the controls on storage tanks might pass.

Table 2 presents the analysis in present value terms based on the assumption that the regulation is in place for 30 years. The results suggest that EPA's Option 2 could result in a present value net *cost* in the high tens to low hundreds of millions of dollars. For example, using a 5 percent discount rate yields net costs that range from about 80 to 200 million dollars.[9]

3. A Critique of EPA's Analysis

We support EPA's efforts to consider a wide range of control alternatives, but the agency could have done more. For example, because the minimal risk reduction did not warrant the high costs, EPA rejected a possible control measure for process wastewater streams that had an average cost of $410,000 per ton of reduced hazardous air pollutants. The agency, however, focuses on Option 2 in its presentation of results because that is the only regulatory alternative that affects cancer incidence. We believe that EPA should have at least considered in more detail the benefits and costs of controlling storage tanks alone because these appear to have the possibility of yielding positive net benefits.

EPA also focused exclusively on command-and-control alternatives. Part of the Clean Air Act calls for recommendations for legislation regarding the remaining risk from hazardous air pollutants. EPA, however, determined that the current legislation provides "a comprehensive and flexible strategy for addressing a variety of air toxics risk concerns" (EPA, 1999). In our view, EPA should have considered other alternatives. There could be much to be gained by at least considering market-based alternatives for reducing hazardous air pollutants. If the activity in question involves relatively small changes in risk, and overall risks are being reduced, some kind of trading regime could be appropriate (such as the sulfur dioxide allowance trading program) (Stavins, 1998). Such

[9] Net costs are calculated as total costs minus total benefits.

an approach has the potential to reduce hazardous air pollutants at a lower cost than conventional, command-and-control alternatives. For example, one might allow trading of different kinds of pollutants based on a trading ratio that reflected damages. At a minimum, one might consider applying a plant-wide bubble for all hazardous air pollutant emissions based on toxicity. That would allow emission sources within a plant to take advantage of differences in marginal costs of pollution control.

Although it may not be worthwhile for EPA to implement an emissions trading regime for the synthetic organic chemical manufacturing industry, it may be desirable to do this on a larger scale, perhaps considering an approach to trading VOC on a regional basis. In the future, Congress should take these alternatives into account when designing new air pollution legislation.

4. Analyzing Minor Rules

Analysis of minor rules serves several purposes. One is to help determine the net benefits of particular options. A second purpose is to highlight other approaches that may be more efficient or equitable. Scholars have debated whether most minor rules are likely to pass a benefit-cost test (see, *e.g.*, Parker, 2003; Hahn, 2004), but that debate has so far lacked much data. Here, we provide some specific recommendations for how to approach the analysis of minor rules in order both to improve agency decision making and advance scholarly research.

All minor rules

The public has a right to know the underlying rationale for a regulation. Thus, a regulatory agency should be required to note the rationale for regulation. This rationale should generally specify the market failure that is being addressed, such as pollution. In addition, an agency should at least qualitatively explain why benefits are likely to be greater than costs (Arrow et al., 1996). To comply with this recommendation, agencies would be required to expend only the most modest resources. It is similar to a new amendment President George W. Bush made to Executive Order 12866, which subjects non-binding agency guidance documents to some of the same standards as federal regulations (Hahn & Litan, 2007).

Minor rules with completed analyses

In general, the agency should provide a benefit-cost analysis similar to the one presented here when doing so would require only a modest additional effort. In this particular case, for example, EPA had already completed the cost analysis and risk assessment, which is likely to be the most expensive part of the preparation of a full regulatory impact analysis. The fact that an agency is not required to compare costs with benefits should not keep it from conducting a benefit-cost analysis when the agency has already developed the individual components needed for such an analysis.

More generally, the agency may want to consider applying certain rules of thumb to its minor rules, as a way of conducting even a crude benefit-cost analysis. One way of simplifying the analysis is to make rough estimates of the benefits that could result from certain kinds of pollution. Such an analysis could use some simple rules of thumb for benefits or costs (or both), as was done here in the case of benefits. Benefits transfer methodology, or using available information in another context, may be helpful, though it does have its drawbacks since the benefits would not be calibrated for the specific circumstance (Kirchhoff et al., 1997).

Allocating analytical resources to minor rules

Of course, not every minor rule will already have a completed analysis or be linked to relevant benefits through benefits-transfer. Doing an economic analysis from scratch may take significant resources. The Congressional Budget Office (1997) found that the average cost of an economic analysis for a major rule is $700,000, ranging from about $18,000 to $8 million. We therefore recommend that an agency base its decision to allocate additional resources to benefit-cost analysis on the expected value of the improved information. An agency should consider using lower cost and lower quality benefit-cost analyses for problems in which the value of improved information is likely to be lower (Raiffa, 1968). In many cases, an analysis from scratch will not be worth it. At the same time, the analysis of a novel problem with implications for future rules could be worthwhile.

The decision on the level of analysis should probably be based on the specific rule and not on an arbitrary cut-off. The current cost threshold of $100 million for analysis may or may not prove to be a reasonable rule of thumb. For example, there are some major proposed regulations for which the agency has little flexibility in policy design given statutory constraints. Thus, OIRA may want to devote fewer resources to doing an economic analysis of those regulations and more to other rules where analysis could make a real difference in policy design.

Minor rules with de minimis risk reduction

There is an alternative way of thinking about the regulatory issues raised here that could involve the application of a kind of risk reduction threshold approach. The idea is that if the regulation has only a very small impact on risk, and its primary aim is to reduce that risk, then it probably is not worth considering. In the case of EPA's hazardous air pollutant proposal, the agency estimated that one cancer case would be prevented every 100 years. Preventing 0.01 cancers each year is unlikely to pass a benefit-cost analysis unless the costs are also very small or other significant benefits exist.

The agency or Congress could consider applying a rule of thumb that would specify a threshold level of risk reduction that needs to be achieved before some kinds of regulation are considered (Adler & Posner, 2006). It would then be the agency's burden to show why that small risk reduction is worth pursuing in the specific circumstance. The basic idea is that when not much is at stake, there may be little reason to regulate.

Similar proposals have been made for dealing with risks that are very small (Sunstein, 2002). In particular, some scholars have advocated not regulating risks that are viewed as "de minimis," or extremely small (Byrd III & Lave, 1987; Whipple, 1987; Wilson, 1988; Rosenthal et al., 1992). Our approach is related to the de minimis risk idea, but not the same thing. If the total risk being addressed is tiny, or de minimis, the risk reduction due to a regulation focusing on that category will necessarily be tiny. Thus, the benefits would exceed costs only if the costs were similarly tiny. Tiny risk reductions from a regulation might also occur, however, when the total risk being addressed is larger but the proposed regulation is simply not expected to reduce that risk to any great extent.

Simple rules of thumb like de minimis risk and our proposed de minimis risk reduction threshold are not without their problems. In particular, they may not necessarily maximize net benefits in all cases. In a world in which analysis is not costless and agencies' budgets are constrained, however, rules of thumb may represent a useful way of setting priorities. They would also give agencies an incentive to combine rules or other policy measures so that the overall risk reduction impacts were larger. In the hazardous air pollutants rulemaking we have examined, EPA was required by Congress to assess the residual risk and promulgate standards if the excess risk rose above one in one million for a maximally exposed person. We believe that such inflexible legislative measures could lead to a misallocation of resources.

5. Conclusion

We know relatively little about the economic impacts of minor rules. Yet, these rules could be important, particularly considering the aggregate impacts of a large number of them. Moreover, small rules are only one category of regulation where our knowledge is quite limited. There are a host of other activities, including registration, licensing decisions, and regulatory guidance, where the economic benefits and costs of agency decisions are not well understood.

We provide an economic analysis of one proposed rule that is not economically significant. Though this rule might not be representative of all small rules, it may be representative of *residual risk* rules. EPA considered two options in this rule: retaining the current set of controls, or adding three additional control measures. On the basis of our preliminary analysis, we would not suggest adding the three additional control measures because they appear to fail a benefit-cost test. However, one of these control measures may pass a benefit-cost test and be appropriate for EPA to require synthetic organics chemical manufacturers to implement.

EPA and Congress may want to consider revising the approach to managing residual risks from hazardous air pollutants. If the benefits of reducing these risks are small in comparison to the costs of reducing them, as the preliminary analysis of one rule here suggests, such regulation may not be warranted. If the maximum risk reductions do not exceed a certain threshold, the agency may do best simply by not moving forward with such rules. If Congress nonetheless believes a regulation is warranted for other reasons, it should allow or even encourage the agency to consider more flexible market-based alternatives for reducing such risks.

We recommend that regulatory agencies base their decisions to allocate additional resources to benefit-cost analysis on the expected value of the improved information. In the application considered here, this implies using crude estimates of benefits and simplifying the cost calculation. We think that agencies should develop methods and statistics that would make it easier to implement such analyses where appropriate. One example, relevant to the case of residual risks, is to develop a table that provides a dollar value per ton of pollutant reduced.

We believe that it is important for scholars to consider the impact of small rules at all levels of government. One way of addressing the problem would be to choose a list of small rules from a variety of agencies at random and examine their economic consequences. This research could provide insights into the potential economic importance of such rules. It could also provide information on how to utilize analysis and analytical resources more effectively to improve public policy.

References

Adler MD, Posner EA (2006) *New Foundations of Cost-Benefit Analysis*. Harvard University Press, Cambridge, MA and London, UK.

Arrow KJ, Cropper ML, Eads GC, Hahn RW, Lave LB, Noll RG, Portney PR, Russell M, Schmalensee R, Smith VK, and Stavins RN (1996) Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation? *Science* 272, 221-222.

Byrd III D, Lave LB (1987) Significant Risk is Not the Antonym of De Minimis Risk. In: Whipple C (ed) *De Minimis Risk*, pp. 41-60. Plenum Press, New York, NY.

Congressional Budget Office (1997) Regulatory Impact Analysis: Costs at Selected Agencies and Implications for Legislative Process. CBO Papers.

Crandall RW, DeMuth C, Hahn RW, Litan RE, Nivola PS, Portney PR (1997) *An Agenda for Federal Regulatory Reform*. American Enterprise Institute and the Brookings Institution, Washington, DC.

Dockins C, Maguire K, Simon N, Sullivan M (2004) Value of Statistical Life Analysis and Environmental Policy: A White Paper for Presentation to Science Advisory Board - Environmental Economics Advisory Committee. Environmental Protection Agency, Office of Policy, Economics and Innovation, National Center for Environmental Economics.

Environmental Protection Agency (1997) Economic Analysis for the National Emission Standards for Hazardous Air Pollutants for Source Category: Pulp and Paper Production; Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards: Pulp, Paper, and Paperboard Category-Phase 1. OAQPS. Research Triangle Park, NC.

_____ (1999) Residual Risk Report to Congress. EPA-453/r-99-001. OAQPS. Research Triangle Park, NC.

_____ (2006) Part II: EPA - National Emission Standards for Hazardous Air Pollutants for Organic Hazardous Air Pollutants from the Synthetic Organic Chemical Manufacturing Industry; Proposed Rule. *Federal Register* 71(114), 34422-34446.

Hahn RW (2004) In Defense of the Economic Analysis of Regulation. *University of Chicago Law Review* 71(3), 1021-1054.

Hahn RW, Litan RE (2007) The President's New Executive Order on Regulation. *The Economists' Voice* 4(2).

Kirchhoff S, Colby BG, LaFrance JT (1997) Evaluating the Performance of Benefit Transfer: An Empirical Inquiry. *Journal of Environmental Economics and Management* 33, 75-93.

Lave LB (1996) Benefit-Cost Analysis: Do the Benefits Exceed the Costs? In: Hahn RW (ed) *Risks, Costs, and Lives Saved*, pp. 104-134. The AEI Press, Washington, DC.

Office of Management and Budget (2001) Presidential Review of Agency Rulemaking by OIRA.

_____ (2003) Circular A-4: Regulatory Analysis.

_____ (2004) Progress in Regulatory Reform: 2004 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities. Office of Information and Regulatory Affairs, Washington, DC.

_____ (2006) Draft 2006 Report to Congress on the Costs and Benefits of Federal Regulations. Office of Information and Regulatory Affairs, Washington, DC.

Oommen R (2006a) Memorandum to Randy McDonald, U.S. Environmental Protection Agency, OAQPS: Summary of Costs for HON Control Options, Eastern Research Group, Inc.

_____ (2006b) Memorandum to Randy McDonald, U.S. Environmental Protection Agency, OAQPS: Storage Vessel Emission Reduction and Control Cost Estimates, Eastern Research Group, Inc.

_____ (2006c) Memorandum to Randy McDonald, U.S. Environmental Protection Agency, OAQPS: Process Vent Emission Reduction and Control Cost Estimates, Eastern Research Group, Inc.

_____ (2006d) Memorandum to Randy McDonald, U.S. Environmental Protection Agency, OAQPS: Cost and Emission Reductions for Meeting Percent Leaker Requirements for HON Sources, Eastern Research Group, Inc.

Parker R (2003) Grading the Government. *University of Chicago Law Review* 70(4), 1345-1486.

Portney PR (1990) Economics and the Clean Air Act. *Journal of Economic Perspectives* 4, 173-81.

Raiffa H (1968) *Decision Analysis: Introductory Lectures on Choices Under Uncertainty*. Addison-Wesley Publishing Company, Inc., Reading, MA.

RegInfo.gov (2005) E.O. 12866: Reviews Completed -- CY 2005. August 4, 2006. <http://www.reginfo.gov/public/do/XMLReportList>.

Rosenthal A, Gray GM, and Graham JD (1992) Legislating Acceptable Cancer Risk from Exposure to Toxic Chemicals. *Ecology Law Quarterly* 19, 269-363.

Stavins RN (1998) What Can We Learn from the Grand Policy Experiment? Lessons from SO2 Allowance Trading. *Journal of Economic Perspectives* 12(3), 69-88.

Stikkers D (2004) The Risk Regulation Landscape for Transportation Fuels: An Empirical Study. Center for the Study and Improvement of Regulation, Carnegie Mellon University.

Sunstein CR (2002) *Risk and Reason: Safety, Law, and the Environment*. Cambridge University Press, Cambridge, UK.

U.S. House Committee on Energy and Commerce (1990) Clean Air Act Amendments of 1990. 101st Cong., 1st sess., H. Rept. 101-409. GPO (Clean Air Act 1990), Washington, DC.

Wilson R (1988) Measuring and Comparing Risks to Establish a De Minimis Risk level. *Regulatory Toxicology and Pharmacology* 8(3), 267-82.

Whipple C (1987) Application of the De Minimis Concept in Risk Management. In: Whipple C (ed) *De Minimis Risk*, pp. 41-60. Plenum Press, New York, NY.

Table 1

Estimates of the Costs and Benefits of Controlling Volatile Organic Compounds on an Annual and Per Ton Basis (in thousands of 2003 dollars)

			Storage Tanks	Process Vents	Leaking Valves	Option 2
	Annualized Cost		200	3,000	10,000	13,200
	Annualized Benefit	Low	100	700	1,000	1,800
		High	600	3,000	5,000	8,600
	Net Annual Benefits	Low	-40	-3,000	-9,000	-12,040
		High	400	-200	-5,000	-4,800
3%	*Annualized tons of VOC*		210	1,100	1,600	2,910
	Cost/ton		0.8	3	6	5
	Benefit/ton	Low	0.6	0.6	0.6	0.6
		High	3	3	3	3
	Net Benefits per ton	Low	-0.2	-2	-5	-4
		High	2	-0.2	-3	-2
	Annualized Cost		200	4,000	10,000	14,200
	Annualized Benefit	Low	100	700	1,000	1,800
		High	600	3,000	5,000	8,600
	Net Annual Benefits	Low	-50	-3,000	-9,000	-12,050
		High	400	-400	-5,000	-5,000
5%	*Annualized tons of VOC*		210	1,100	1,600	2,910
	Cost/ton		0.9	3	6	5
	Benefit/ton	Low	0.6	0.6	0.6	0.6
		High	3	3	3	3
	Net Benefits per ton	Low	-0.3	-3	-5	-4
		High	2	-0.4	-3	-2
	Annualized Cost		200	4,000	10,000	14,200
	Annualized Benefit	Low	100	700	1,000	1,800
		High	600	3,000	5,000	8,600
	Net Annual Benefits	Low	-70	-3,000	-9,000	-12,070
		High	400	-600	-5,000	-5,200
7%	*Annualized tons of VOC*		210	1,100	1,600	2,910
	Cost/ton		0.9	3	6	5
	Benefit/ton	Low	0.6	0.6	0.6	0.6
		High	3	3	3	3
	Net Benefits per ton	Low	-0.3	-3	-5	-4
		High	2	-0.5	-3	-2

Notes: Cost numbers are based on Oommen (2006a), Oommen (2006b), Oommen (2006c) and Oommen (2006d). Benefit numbers are taken from EPA (1997) and updated using the Consumer Price Index. Net annual benefit values for the three control options will not equal the difference between costs and benefits due to rounding to one significant digit.

Table 2

Present Value Estimates of the Costs and Benefits of Controlling Volatile Organic Compounds Based on a 30 year Regulation (in millions of 2003 dollars)

Net Present Value			Option 2
3%	Cost		300
	Benefit	Low	40
		High	200
	Net Benefit	Low	-200
		High	-100
5%	Cost		200
	Benefit	Low	30
		High	100
	Net Benefit	Low	-200
		High	-80
7%	Cost		200
	Benefit	Low	20
		High	100
	Net Benefit	Low	-100
		High	-70

Notes: Cost numbers are based on Oommen (2006a), Oommen (2006b), Oommen (2006c) and Oommen (2006d). Benefit numbers are taken from EPA (1997) and updated using the Consumer Price Index. The length of the model is 30 years. Numbers may not sum to totals due to rounding to one significant digit.

Appendix

This Appendix describes the definition of risk in detail and presents our modeling assumptions for the benefit-cost analysis and results from the sensitivity analysis. We found that our qualitative conclusions did not change with a range of discount rates, benefit numbers, cost assumptions, additional hazardous air pollutant benefits, and assumed length of project.

1. Note on Risk

The cancer risks associated with inhalation exposure were calculated using lifetime cancer risk estimates, which assume 70 years of exposure 24 hours a day for all individuals in a given location. This does not necessarily represent the true risk, but rather a conservative risk level that is "an upper bound that is unlikely to be exceeded" (EPA, 2006). The non-cancer risks were calculated using a hazard quotient and index which also assume continuous lifetime exposure (EPA, 1999, 127-128; EPA, 2006, 34428-34432). The maximum individual lifetime cancer risk associated with any source was estimated to be about 100 in one million, though a majority of facilities had risks of ten in one million or less (EPA, 2006, 34431).

2. Modeling Assumptions for the Benefit-Cost Analysis

Costs

Costs consist of capital and operation and maintenance costs. On the cost side, we use EPA's estimates from a number of documents, specifically from a series of memorandums from Roy Oommen, from the Eastern Research Group, Inc., to Randy McDonald, from EPA, OAQPS, located in the public docket (Docket ID No. EPA-HQ-OAR-2005-0475; Oommen, 2006a; Oommen, 2006b; Oommen, 2006c; Oommen, 2006d). Cost estimates were based on results from 104 assessed facilities and extrapolated to the entire source category of 238 eligible facilities. We assume for simplicity that the costs and benefits of the control measures are additive. This assumption appears reasonable given that the specified tons of hazardous air pollutants and volatile organic compounds reduced per year by each control measure individually sum to the specified total tons of hazardous air pollutants and VOC reduced per year for Option 2, which includes all three control measures. This assumption was also confirmed in a conversation between Caroline Cecot and Larry Sorrels on August 3, 2006.

Annualization error

We correct for an error EPA appears to have made when calculating annualized capital costs for implementing storage tank control measures at one of the manufacturing plants. To calculate annualized capital costs, EPA multiplies the total estimated capital cost by the capital recovery factor, which was calculated assuming an interest rate and a specific repayment period. We vary this interest rate in our sensitivity analyses. For the storage tank control measures, the repayment period was 10 years (Oommen, 2006b). The costs for storage tank control measures consist of the cost of installing internal floating roofs on uncontrolled tanks that emit greater than 5 tons per year of hazardous air pollutants (EPA, 2006, 34434). For the process vent control measures, the repayment period was 15 years (Oommen, 2006c). The cost for process vent control measures consists of the cost of applying a thermal oxidizer on a vent stream based on various properties (EPA, 2006, 34433). There were no capital costs associated with the control measures to reduce the percentage of leaking valves (Oommen, 2006d).

Although Oommen (2006b) calculates a capital recovery factor of 0.14 for storage tank control measures, the total capital cost of facility #254 of $304,488 was annualized to a recovery cost of $11,734. This would imply a capital recovery factor closer to 0.06. The annualized recovery cost should be $42,628. This error was confirmed in a telephone conversation between Caroline Cecot and Roy Oommen on August 7th, 2006.

The effect is to raise control costs for this particular manufacturing plant by about 70 percent. Because EPA scales all results to the national level by a factor of 2.3, this error compounds itself. The effect is to raise the total control costs for storage tanks by about 50 percent. We ran the model with and without this change and it does not affect our qualitative conclusions. The correction does affect the attractiveness of storage tank control measures. Control measures for storage tanks would have passed a benefit-cost test under the low-benefit per ton assumption for VOC emission reductions if we had not made the correction.

Recovery credits

EPA assumes in the case of implementing control measures for storage tanks and for leaking valves that there is a “recovery credit” for product waste reduced. The source of this credit is unclear in EPA documentation. If the credit were eliminated, total costs would increase by 10 percent, but it would not affect our qualitative conclusions.

Benefits

EPA includes estimates of the tons of VOC reduced and the tons of hazardous air pollutants reduced. EPA uses 2,000 lbs per ton, confirmed in an email conversation between Caroline Cecot and Randy McDonald on August 14th, 2006. We express cost and benefits per ton in terms of VOC. Since hazardous air pollutants are a subset of volatile organic compounds, hazardous air pollutant reductions represent part of the VOC reduced. Thus, if we only focused on hazardous air pollutant reductions, we would not count benefits from other VOC that were reduced as part of the control measure. Incidentally, the cost per cancer case prevented of Option 2 is more than $1.3 billion, which does not account for many other important benefits, say, from the reduction of ozone.

Unlike EPA, we consider non-cancer benefits such as ozone reductions as well as cancer benefits in our discussion. The benefit numbers come from an EPA (1997) regulatory impact assessment that specified a range of $444 to $2007 (1990 dollars) for each ton of VOC reduced. This defines a generic benefit number that includes the total value of the ozone health and welfare benefits from VOC reductions. We assume the phrase “health and welfare” incorporates both the adverse health effects caused by hazardous air pollutants, which includes cancer, and the adverse effects of VOC that contribute to ozone. We do a sensitivity analysis in which we add the cancer reduction benefits calculated by EPA from hazardous air pollutant reductions to the total benefit ranges for VOC reduced and find that our qualitative conclusions do not change

We assume these benefit numbers remain constant for each ton reduced. That is, we assume the marginal benefit curve is horizontal, which may be reasonable for small reductions in pollutants, but probably not reasonable for large reductions. A more extensive analysis involving modeling approaches would take into account a number of relevant factors, such as the potentially different contribution of hazardous air pollutants to ozone formation, and the corresponding effects these changes have on human health and welfare. For example, one would expect the dollar per ton benefit estimate to vary by location due to weather and population exposed, among other factors.

EPA estimated that Option 2 would reduce annual cancer incidence by 0.01, or, prevent one cancer every 100 years for the exposed population. The generic benefit number for reducing a ton of VOC should already include the benefits of reducing hazardous air pollutants as well, so we do not add any additional benefits for hazardous air pollutants in our main calculation. We did a sensitivity analysis in which we added the monetary value of one life saved per 100 years in addition to the benefit numbers for each ton of VOC reduced, and found that our conclusions do not change even though this would tend to overestimate the benefits. This analysis is described below. We use the endpoints of the benefit range for the purposes of sensitivity. The benefit per ton ranges from about $600 to about $2800 (2003 dollars). EPA did not provide a most likely value, or we would have used that. We think, in general, it is good to include most likely or expected values in the primary analysis.

3. Modeling Assumptions for the Sensitivity Analysis

Hazardous air pollutant benefit

The generic benefit number for reducing a ton of VOC should include the benefits of reducing hazardous air pollutants as well. We present a sensitivity analysis in which we add the total benefit EPA estimates from cancer reduction for Option 2. EPA predicts a cancer risk reduction of 0.01, which is statistically equivalent to preventing one cancer case every 100 years. For simplicity, we assume that one cancer case is equal to one life. Given that the cancers associated with the hazardous air pollutants that resulted in the highest individual cancer risk estimates are leukemia and respiratory cancer—both terminal cancers—this assumption is reasonable. We use $6.8 million as our estimate of the value of a statistical life, which is the value of a statistical life estimate EPA advises its analysts to use, updated to 2003 dollars (Dockins et al., 2004).

Since Option 2 is estimated to prevent one cancer every 100 years, we assumed that it saves 0.01 of the value of a statistical life each year, or $68,000 each year. This value is derived from annualized cancer risk reduction and the value of a statistical life, 0.01 multiplied by $6.8 million. This did not change our qualitative results. A more complete analysis might consider the benefits of hazardous air pollutant reductions and non-hazardous air pollutant reductions separately. This is likely to yield a lower range for total benefits than the one we calculated by simply adding the cancer reduction benefits to total ozone reduction benefits. Thus, our sensitivity analysis would overstate the benefits if all of the other values were accurate.

Length of model

For simplicity, given that the two required capital technologies had repayment periods of 10 and 15 years respectively, we assumed a 30 year length of model for our presentation of the net present value of the future costs of Option 2. Using a 15 year scenario reduces the present value by 32% and using a 60 year scenario increases the present value by 23% for a discount rate of 5%. Since the ratio of benefits to costs is the same no matter what length of model is assumed, this does not effect our qualitative conclusions.

We did not consider variations in the cost of implementing various control measures, nor did we consider possible interaction effects, but such analyses might be worthwhile doing. In doing these sensitivity analyses, we think it is useful to try to follow the Office of Management and Budget guidelines where they are appropriate. See Office of Management and Budget discussion on guidelines for regulatory analyses (2003).