March 1985

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Arsenic, ASARCO, and EPA: Cost-Benefit Analysis, Public Participation, and Polluter Games in the Regulation of Hazardous Air Pollutants*

Gregory D. Call**

INTRODUCTION

The regulation of arsenic emissions poses three recurring issues of environmental regulation: (1) the role that cost-benefit analysis should play in environmental decisions; (2) the extent to which the public should participate in environmental decisions; and (3) the problem of strategic behavior and the measures that EPA can take to prevent strategic behavior.1 This Comment will examine these three issues in the context of EPA’s regulation, under section 112 of the Clean Air Act, of arsenic emitted from the ASARCO copper smelter in Tacoma, Washington.2 These issues are particularly timely in light of current consideration of amendments to section 112.3

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* An earlier draft of this Comment received first prize in the 1985 Ellis J. Harmon Environmental Law Writing Competition.

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1. Strategic behavior as discussed here involves misrepresentation by the regulated firm which is intended to deceive the regulator.


In fact changes to § 112 were proposed in 1984. The proposed changes, however, did not include authority to consider costs and benefits. Rather the primary goal of the proposed legislation was to speed up EPA regulation of hazardous air pollution. H.R. 5084, 98th Cong., 2d Sess., 130 CONG. REC. 1514-15 (1984).

In 1984 EPA also actively began to study the extent of the hazardous air pollutant problem and sought comments on a draft document it prepared discussing the extent of the prob-
The harmful effects of arsenic have been known to movie buffs for many years. Only recently, however, have scientists discovered that airborne arsenic poses a cancer threat.\(^4\) In July 1983, after pressure from Congress and the courts, EPA proposed regulations under section 112 of the Clean Air Act to control airborne arsenic emissions from the ASARCO-Tacoma smelter and other sources.\(^5\)

The ASARCO-Tacoma smelter spews more arsenic into the air than any other source in the nation.\(^6\) EPA estimates that the smelter exposes 370,000 persons to potentially harmful concentrations of arsenic.\(^7\) In April 1983, EPA initiated efforts to regulate ASARCO's arsenic emissions under section 112.\(^8\) The following July, EPA published its proposed standards for arsenic emissions.\(^9\) When it became apparent that promulgating standards might force ASARCO to close the smelter, EPA Administrator Ruckelshaus proposed that the citizens of Tacoma be given a voice in determining whether the smelter should be shut down.\(^10\) EPA subsequently held public hearings and distributed public comment forms in an effort to measure public opinion.\(^11\) Before EPA could promulgate final regulations, however, ASARCO announced that it would close the smelter.\(^12\)

The first part of this Comment examines section 112 of the Clean Air Act. The second part discusses the ASARCO smelter as a setting for


\(^5\) See infra notes 35-50 and accompanying text.

\(^6\) See infra note 47 and accompanying text.


\(^8\) Environmental Protection Agency, INORGANIC ARSENIC EMISSIONS FROM HIGH-ARSENIC PRIMARY COPPER Smelters—BACKGROUND INFORMATION FOR PROPOSED STANDARDS (1983) [hereinafter cited as EPA BACKGROUND INFORMATION].

\(^9\) EPA Proposed Arsenic Standards, supra note 7, at 33,112.

\(^10\) See infra notes 57-58 and accompanying text. Interestingly, Ruckelshaus resided in the Tacoma area before his return to EPA.

\(^11\) See infra notes 62-65 and accompanying text.

\(^12\) See infra note 75 and accompanying text.
the regulation of arsenic emissions. The third part examines the first substantive issue, the use of cost-benefit analysis in regulating the emissions of hazardous air pollutants, including the application of cost-benefit analysis to situations where increased emission regulation may lead to plant shutdowns. This part also contrasts standards based on a cost-benefit approach with standards based on a health effects approach. The fourth part examines the role of the public in making decisions regarding hazardous air pollutant emissions. This Comment examines public participation through both market and nonmarket mechanisms and then contrasts public participation, in general, with expert decisionmaking. The final part examines the extent to which regulated firms engage in strategic behavior to deceive the regulator and the ability of EPA to prevent such behavior.

I

SECTION 112 OF THE CLEAN AIR ACT

A. The Statute

EPA possesses authority to regulate arsenic emissions under section 112 of the Clean Air Act. Section 112 requires national emissions standards for hazardous air pollutants. The statute defines a hazardous air pollutant as a pollutant emitted by a stationary source which "causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness." Under section 112, the Administrator lists a pollutant as a hazardous air pollutant and then must publish proposed emission standards within 180 days after it is listed. The standard the Administrator sets must provide "an ample margin of safety to protect the public health from such hazardous air pollutant."

A literal interpretation of section 112 requires EPA to consider only health factors in setting emission levels for hazardous air pollutants. Since it contains no language modifying the "ample margin of safety"

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Within 180 days after the inclusion of any air pollutant in [the hazardous air pollutant list, see id. at 7412(b)(1)(A)], the Administrator shall publish proposed regulations establishing emission standards for such pollutants together with a notice of a public hearing within thirty days. Not later than 180 days after such publication, the Administrator shall prescribe an emission standard for such pollutant, unless he finds, on the basis of information presented at such hearings, that such pollutant clearly is not a hazardous air pollutant. The Administrator shall establish any such standard at the level which in his judgment provides an ample margin of safety to protect the public health from such hazardous air pollutant.

14. Id. § 7412(a)(1).
15. Id. § 7412(b)(1)(A).
16. Id. § 7412(b)(1)(B).
17. Id.
standard, the statute suggests that EPA may not consider cost considerations in promulgating standards.\textsuperscript{18} Section 112 would, therefore, seem to mandate a health-only approach to the regulation of hazardous emissions.

\textbf{B. EPA's Approach}

Despite the language of section 112, EPA has not accepted the health-only approach to regulating hazardous air pollutants.\textsuperscript{19} EPA assumes that there is no threshold concentration below which a hazardous pollutant causes no health effects.\textsuperscript{20} If no thresholds exist, then a literal interpretation of section 112's language would require closure of all plants emitting hazardous air pollutants. Since EPA has not closed all of these plants, its regulatory approach must reflect some cost considerations.\textsuperscript{21}

EPA has developed a three-step process for regulating hazardous pollutants under section 112. This process explicitly considers the costs and benefits of control.\textsuperscript{22} In step one, EPA categorizes sources of pollu-

\begin{itemize}
\item \textsuperscript{18} See, e.g., D. Currie, \textit{Air Pollution: Federal Law and Analysis} 3-89 to 3-90 (1981); W. Rodgers, \textit{Environmental Law} 277-78 (1977). The statute does allow EPA to consider nonhealth factors, but only at the stage of granting waivers to promulgated standards. 42 U.S.C. § 7412(c)(1), (2) (1982). The Administrator, \textit{id.} § 7412(c)(1), and the President, \textit{id.} § 7412(c)(2), may grant two year waivers.
\item \textsuperscript{20} In the preamble to the proposed standards for the first three pollutants EPA regulated under § 112, the Agency explicitly indicated that the standards were partly based on nonhealth factors, including economic factors. National Emission Standards for Hazardous Air Pollutants: Proposed Standards for Asbestos, Beryllium and Mercury, 36 Fed. Reg. 23,239 (1971). The final standards for these three substances, however, contain no explicit reference to nonhealth factors. Yet, the final asbestos regulations specifically note that a total ban is not required since such a ban would "result in the prohibition of many activities which are extremely important." National Emission Standards for Hazardous Air Pollutants: Final Standards for Asbestos, Beryllium and Mercury, 38 Fed. Reg. 8820 (1973). See generally, Doniger, \textit{Federal Regulation of Vinyl Chloride: A Short Course in the Law and Policy of Toxic Substances Control}, 7 Ecology L.Q. 497, 569-76 (1978) (discussion of EPA's interpretation of section 112).
\item \textsuperscript{21} EPA Proposed Arsenic Standards, \textit{supra} note 7, at 33,113-14.
\item \textsuperscript{22} Doniger, \textit{supra} note 19, at 571.
\item \textsuperscript{22} EPA Proposed Arsenic Standards, \textit{supra} note 7, at 33,125-26.
\end{itemize}
tion to determine whether they pose a "significant risk" to public health.\textsuperscript{23} If EPA determines a source category poses a significant risk, the Agency moves on to step two.

In step two, EPA determines the best available technology (BAT) for that source. \textquotedblleft BAT is the technology which, in the judgment of EPA, is the most advanced level of control which is adequately demonstrated considering environmental, energy, and economic impacts.\textsuperscript{24} In the case of ASARCO, the technology EPA selected was secondary hooding.\textsuperscript{25} EPA selected this technology because it was \textquotedblleft the most advanced level control the smelter could afford without closing.\textsuperscript{26}

Finally, EPA compares the benefits of controlling emissions beyond the BAT point with the costs of such control.\textsuperscript{27} Where additional controls would require the plant to close, EPA compares the health benefits of moving beyond the BAT emission level to zero emissions with the cost of a shutdown.\textsuperscript{28} If the benefits of a shutdown outweigh the costs, EPA elects to close the plant.\textsuperscript{29}

II

HISTORY OF ARSENIC EMISSIONS AT THE ASARCO SMELTER

A. Establishment of the ASARCO Smelter

ASARCO began smelting copper at the Tacoma site in 1890.\textsuperscript{30} Fifteen years later, the town of Ruston was incorporated around the smelter taking the smelter out of the jurisdiction of Tacoma. This insulated the smelter from local regulation, since all of the tax benefits flowed to Ruston while only a small percentage of the environmental costs were borne by Ruston and its inhabitants.\textsuperscript{31} The people of Tacoma bore the pollution costs of the smelter's operation, but could do little to modify its

\begin{itemize}
  \item \textsuperscript{23} See id. at 33,126.
  \item \textsuperscript{24} Id. at 33,125.
  \item \textsuperscript{25} Id.
  \item \textsuperscript{26} Id.
  \item \textsuperscript{27} See id. at 33,116, 33,126.
  \item \textsuperscript{28} See id. at 33,126
  \item \textsuperscript{29} EPA has described its test slightly differently. According to EPA, it first determines whether emissions pose a significant health risk. EPA Proposed Arsenic Standards, \textit{supra} note 7, at 33,116. If they do, EPA moves into its three step test. \textit{Id.} at 33,125-26. The steps are: 1) evaluate whether current controls reflect BAT; 2) if they do not, select BAT; and 3) using a cost-benefit analysis, consider whether standards beyond BAT should be selected. \textit{Id.} The two descriptions are essentially identical but the three step test described in the text more accurately describes EPA's reasoning process.
  \item \textsuperscript{30} Chasan, \textit{Sunset for the Smelter?}, Seattle Weekly, Aug. 24, 1983, at 29. The copper smelting process usually involves three steps. The raw material is roasted to remove a portion of the sulfur. The roasted product is then smelted to form a material with a greater copper concentration. This material is then converted (oxidized) to 99% pure copper. EPA BACKGROUND INFORMATION, \textit{supra} note 8, at 2-4. For a description of the process at the ASARCO-Tacoma smelter, see \textit{id.} at 2-19 to 2-21.
  \item \textsuperscript{31} Chasan, \textit{supra} note 30, at 29.
\end{itemize}
operation. As a Tacoma city council member noted, allowing the smelter to spew its pollutants into Tacoma from Ruston was like "somebody standing on the other side of the city line with a thirty-aught-six and firing it into Tacoma."  

From 1968 to 1981, ASARCO successfully delayed state regulation of emissions from the smelter. For example, in January 1972, ASARCO delayed state regulation of sulfur dioxides (SO$_2$) by claiming that the proposed SO$_2$ standard would result in closure of the plant. ASARCO later delayed complying with state enacted arsenic standards on economic affordability grounds as well. Regulation of arsenic emissions thus awaited EPA action.

### B. EPA Regulation of Arsenic Emissions

Although EPA has possessed the authority to regulate arsenic emissions under section 112 of the Clean Air Act since 1970, the Agency took no action until it was forced to do so by Congress and the courts. In 1977, Congress amended the Clean Air Act by adding section 122. This section required EPA to determine specifically whether arsenic emissions might unreasonably endanger the public health. If EPA made this determination, it was, under section 112, to list arsenic as a hazardous air pollutant and then promulgate proposed emission regulations within 180 days. In 1980, EPA listed arsenic as a hazardous air pollutant based on preliminary findings that those exposed to arsenic face a higher probability of contracting lung and skin cancer and that people

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32. Id.
33. See ASARCO v. Air Quality Coalition, 92 Wash. 2d 685, 689-90, 601 P.2d 501, 506 (1979). The Washington Clean Air Act grants the Puget Sound Air Pollution Control Agency (PSAPCA) authority to regulate air pollution emissions. WASH. REV. CODE § 70.94 (West 1975 & Supp. 1985). PSAPCA adopted Regulation I to regulate sulfur dioxide and particulate emissions in the region. The variances ASARCO received were variances to these regulations. Air Quality Coalition, 92 Wash. 2d at 689-90, 601 P.2d at 506.

34. After PSAPCA discovered that residents around the smelter had high arsenic levels in their bodies, it implemented arsenic standards for the ASARCO smelter in 1973. Chasan, supra note 30, at 29. ASARCO sought a variance from the arsenic standards on economic grounds at the same time it was seeking its second variance to the sulfur dioxide standards. Air Quality Coalition, 92 Wash. 2d at 689, 601 P.2d at 506. ASARCO claimed compliance would result in closure of the smelter. Id. at 713, 601 P.2d at 518. The decision by PSAPCA was remanded, however, for failure to provide an environmental impact statement. Id. Ultimately, ASARCO took no action to control arsenic emissions until 1981, when it installed one secondary hood. Chasan, supra note 30, at 30. ASARCO failed to install a second hood claiming that it needed to know what action EPA would require before it acted. Id.

38. Id.
living near stationary sources of arsenic are exposed to ambient concentrations of arsenic that are above the national average.40

Although EPA listed arsenic, it failed to promulgate proposed standards for arsenic emissions within the required 180 days.41 The State of New York brought suit to force EPA to propose arsenic standards. In New York v. Gorsuch,42 the court found EPA in violation of section 112 and granted the Agency 180 additional days to publish proposed standards.43

EPA published a draft environmental impact statement (DEIS) in April 1983 on arsenic emissions from the ASARCO-Tacoma smelter.44 In this study, EPA found that the ASARCO-Tacoma smelter accounted for approximately five percent of domestic blister copper production.45 The study also revealed that ASARCO uses feed that contains four percent arsenic, while other smelters use feed that contains 0.0004% to 0.6% arsenic.46 The study concluded: "the ASARCO-Tacoma smelter introduces more arsenic in the feed material to the smelter than the combined total from all other smelters. . . . As a result, more arsenic is potentially released from this smelter as process emissions and fugitive emissions than from the other smelters combined."47 In the DEIS, EPA analyzed and invited comments on three regulatory alternatives: (1) taking no new action; (2) requiring the installation of secondary hoods and other control technologies; and (3) closing the ASARCO smelter.48 EPA presented estimates of environmental impacts, control costs, and economic impacts for each of the three alternatives.49

Exactly 180 days after the New York v. Gorsuch ruling, on July 11, 1983, EPA published proposed standards on arsenic emissions following its three step approach.50 The proposed standards addressed several sources of arsenic and, like the DEIS, treated the ASARCO-Tacoma smelter separately.51 After assessing BAT for ASARCO, which included

41. Standards were not proposed until 1983. EPA Proposed Arsenic Standards, supra note 7, at 33,112, 33,123.
43. Id. at 1066. The courts have also tried to force EPA to promulgate standards for other hazardous air pollutants. See, e.g., Sierra Club v. Gorsuch, 551 F. Supp. 785 (N.D. Cal. 1982) (EPA ordered to propose national emission standards for radionuclides within 180 days).
44. EPA BACKGROUND INFORMATION, supra note 8.
45. Id. at 2-2. Blister copper is the product of the third step of the smelting procedure and is 99% pure copper. Id. at 2-4.
46. Id. at 2-5.
47. Id. at 2-4.
48. Id. at 1-2.
49. Id. at 5-1 to 7-35.
50. EPA Proposed Arsenic Standards, supra note 7. For a description of EPA's three-step approach, see supra notes 22-29 and accompanying text.
51. Id. at 33,121-23.
the installation of secondary hooding,\textsuperscript{52} the proposed standards concentrated on comparing the benefits and costs of moving beyond BAT and requiring ASARCO to close the smelter.\textsuperscript{53}

As required by step two of its approach, EPA estimated the emissions reduction and cancer reduction associated with BAT. EPA initially estimated BAT would reduce the plant's arsenic emissions from 282 million to 172 million grams per year.\textsuperscript{54} EPA estimated that this reduction would reduce the number of cancers caused by the plant from 1.1 - 17.4 to 0.21 - 3.4 per year.\textsuperscript{55}

In accordance with step three of its process, EPA considered whether the smelter should be required to control emissions beyond the level at BAT. EPA concluded that requiring controls beyond BAT would result in the closure of the ASARCO plant and the loss of 500 ASARCO jobs and 300 other jobs in the area. EPA estimated that local businesses would lose $20 million in revenues, while local governments would lose about $2 million in tax revenues. Faced with these economic impacts, EPA concluded that controlling emissions at BAT was preferable to closing the smelter.\textsuperscript{56}

EPA Administrator Ruckelshaus indicated, however, that the people living around the smelter would have a voice in deciding whether the smelter should be closed. Ruckelshaus stated, "For me to sit here in Washington and tell the people of Tacoma that [the cancer risk associated with arsenic emissions from the smelter] is an acceptable risk would be at best arrogant and at worst inexcusable."\textsuperscript{57} Ruckelshaus said EPA "must ask [the people of Tacoma] if they are willing to accept certain risks associated with exposures to low levels of arsenic."\textsuperscript{58}

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\textsuperscript{52} Id. at 33,123.

\textsuperscript{53} Id. at 33,130.

\textsuperscript{54} Id. at 33,123. EPA later revised pre-control estimates of emissions downward. See infra note 73 and accompanying text.

\textsuperscript{55} EPA Proposed Arsenic Standards, supra note 7, at 33,123. To estimate the risk of cancer EPA first calculated a unit risk number, the risk to an individual of getting lung cancer if the air she breathed throughout her lifetime contained one microgram per cubic meter of arsenic. EPA based its calculations of the unit risk number on studies of lung cancer among workers exposed to arsenic in smelters and at a pesticide plant. Second, EPA estimated the exposure of individuals living within a 12 mile radius of the smelter. By multiplying these two values EPA obtained a cancer risk estimate. Id. at 33,114-15.

These estimates indicate that the lung cancer risk associated with emissions from the ASARCO-Tacoma smelter is a full order of magnitude higher than the risk of emissions from other copper smelters. EPA estimated cancers would decline from \(0.10 - 1.6\) to \(0.04 - 0.64\) after the installation of BAT at plants smelting low arsenic content copper ore. Id. at 33,122-27.

\textsuperscript{56} Id. at 33,131.

\textsuperscript{57} N.Y. Times, July 16, 1983, at 22, col. 1.

C. Citizen Participation in Setting Standards for the ASARCO-Tacoma Smelter

1. EPA Efforts

The EPA Region 10 office in Seattle coordinated an effort to obtain the views of Tacoma area residents on the tradeoff between jobs and health. These efforts fell roughly into two categories: attempts to educate the people of the tradeoffs, and attempts to gauge the public's opinion of what should be done to control arsenic emissions from the ASARCO smelter.

EPA took several steps to inform the public of the tradeoffs involved. EPA issued numerous press releases explaining the tradeoffs and advertising times of workshops and hearings. The local press did in fact provide extensive coverage of the issue. At the three workshops EPA held, members of the Agency explained the proposed standards and answered questions from community members. At the workshops EPA provided simplified fact sheets which explained the tradeoffs. In addition, EPA provided local libraries with a copy of the administrative record.

EPA attempted to gauge the public opinion by soliciting letters and distributing public comment forms. In addition, a three day hearing, held in November 1983, gave the public an opportunity to voice its position. Over 140 individuals testified at the three day hearing. The majority of the responses favored closure.

2. The Baird Surveys

The Tacoma Public Health Department and Brian Baird, a psychology graduate student, undertook a more complete and scientific survey of public opinion regarding the smelter. Baird conducted two surveys,

59. EPA Region 10, Press Release (July 12, 1983).
62. Interview with Laurie Kral, Docket Clerk in charge of the ASARCO-Tacoma docket, (Nov. 2, 1983) [hereinafter cited as Interview with L. Kral].
64. Interview with L. Kral, supra note 62. The record contained all documents dealing with the rulemaking.
65. Tacoma News Tribune, Nov. 5, 1983, at A-15, col.1. Many of the people who testified at the hearing appeared to have no formal ties to organized interest groups.
66. See infra notes 202-03 and accompanying text.
one of 347 individuals at the three day hearing\textsuperscript{68} and the other of 266 individuals randomly selected from the phone book.\textsuperscript{69} Each survey contained the same thirty-five questions.\textsuperscript{70} This study revealed that a majority of those who attended the hearing favored closure,\textsuperscript{71} while those contacted in the telephone poll were more evenly divided.\textsuperscript{72}

D. \textit{ASARCO's Decision to Close the Tacoma Smelter}

In March 1984, EPA reduced its estimate of current arsenic emissions from the ASARCO smelter from 282 million grams per year to 91 million grams per year.\textsuperscript{73} Despite this revised estimate of existing emissions, EPA officials indicated in June 1984 that the final regulations would impose stricter standards than those set out in its proposed regulations.\textsuperscript{74} Before EPA promulgated its new regulations, ASARCO announced that it would close the Tacoma smelter.\textsuperscript{75} ASARCO cited depressed copper prices, a shortage of copper concentrates, and environmental regulations as the reasons for the closure.\textsuperscript{76} The company indicated that meeting federal and state environmental standards would cost $150 million.\textsuperscript{77}

III

CONSIDERATION OF COSTS AND BENEFITS UNDER
SECTION 112 OF THE CLEAN AIR ACT

Although EPA considered the economic costs of reducing emissions at the ASARCO smelter in its analysis, the extent to which EPA should consider the economic costs and benefits of reducing emissions of hazardous air pollutants under section 112 remains an issue of considerable controversy.\textsuperscript{78} Some economists in and out of government advocate EPA consideration of the costs and benefits of regulation at all stages of the

\begin{itemize}
  \item \textsuperscript{68} See Summary Data, \textit{supra} note 67.
  \item \textsuperscript{69} Baird Preliminary Report, \textit{supra} note 67, at 4.
  \item \textsuperscript{70} See B. Baird, Questionnaire on the ASARCO Smelter (n.d.) (used in Tacoma-Pierce County Public Health Department Survey) (copy on file with ECOLOGY L.Q.).
  \item \textsuperscript{71} See \textit{infra} note 211 and accompanying text.
  \item \textsuperscript{72} See \textit{infra} note 213 and accompanying text.
  \item \textsuperscript{73} \textit{Arsenic Standards for Tacoma Smelter Said to be Tighter than those Proposed}, [14 Current Developments] \textit{ENV'T REP. (BNA)} 297-98 (June 22, 1984) [hereinafter cited as \textit{Arsenic Standards}].
  \item \textsuperscript{74} \textit{Tacoma ASARCO Copper Smelter to Close in June 1985, Company Board Announces}, [14 Current Developments] \textit{ENV'T REP. (BNA)} 388-89 (July 6, 1984) [hereinafter cited as \textit{Smelter to Close}].
  \item \textsuperscript{75} \textit{Smelter to Close, supra} note 74, at 388. The smelter in fact closed on March 25, 1985.
  \item \textsuperscript{76} \textit{Id.}
  \item \textsuperscript{77} \textit{Id.}
  \item \textsuperscript{78} Ruckelshaus has requested that \$ 112 be amended to allow the Administrator to weigh "the costs of a particular control strategy and the benefits of the substances against the risk reduced." Ruckelshaus Statement, \textit{supra} note 3, at 40.
\end{itemize}
ARSENIC EMISSIONS REGULATION

regulatory process.79 Other regulators contend that EPA should ignore cost considerations when promulgating regulations.80 EPA adopts a middle ground; the Agency selects BAT and then examines costs and benefits to determine if the plant should be closed.81 This section examines alternative positions in light of possible plant shutdowns.

A. Cost-Benefit Based Regulation

According to economic theory, a regulator should seek to implement the economically efficient policy. The economically efficient policy is achieved when it is impossible to make any of the parties better off without making any party worse off.82 Since almost all policies will help some individuals and hurt others,83 this definition does not readily lead to the selection of a policy for regulating emissions. Economists have therefore redefined the economically efficient policy as that which maximizes the social welfare.84 Social welfare is defined as the sum of individuals' welfare as measured in dollars.85 Additionally, the theory is that those who gain by a change in policy can hypothetically compensate those who lose, thereby making each party better off and achieving true economic efficiency.86

Table 1 provides a hypothetical illustration of an economist's analysis of the arsenic pollution problem. In this simple world, there are three actors: a company, which pollutes and seeks to maximize profits; a breather, who might also work in the area and seeks to maximize his well being; and a regulator. In this illustration, the regulator can select from three discrete policy choices, all values can be expressed in dollar

80. See infra notes 99-106 and accompanying text.
81. See supra notes 19-29 and accompanying text.
82. J. HIRSCHLEIFER, PRICE THEORY AND APPLICATIONS 441 (1976).
83. Id. at 441; J. HENDERSON & R. QUANDT, MICROECONOMIC THEORY: A MATHEMATICAL APPROACH 308 (1980). For example, closing the ASARCO smelter would hurt residents who would lose their jobs but would benefit other area residents by giving them cleaner air. This, therefore, would not be an economically efficient change in policy in the standard sense.
84. J. HENDERSON & R. QUANDT, supra note 83, at 308.
85. Id. Note there is no correct answer as to how individual welfare should be valued when summed. Id. at 308-15.
terms,\(^8^7\) and pollution control cost does not vary with output.\(^8^8\) The task of the regulator is to choose the policy that maximizes social welfare.

### TABLE 1

<table>
<thead>
<tr>
<th>Policy</th>
<th>Policy 1</th>
<th>Policy 2</th>
<th>Policy 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Control</td>
<td>Firm Profits: $200.00</td>
<td>Breather Benefits: $0.00</td>
<td>Total Social Welfare: $200.00</td>
</tr>
<tr>
<td>50% Control</td>
<td>$125.00</td>
<td>$125.00</td>
<td>$200.00</td>
</tr>
<tr>
<td>100% Control</td>
<td>$0.00</td>
<td>$200.00</td>
<td>$200.00</td>
</tr>
</tbody>
</table>

To determine where social welfare reaches its maximum, the regulator compares the marginal benefits to the breather and the marginal costs to the polluter of additional pollution control. In Table 1 the marginal benefits to the breather of moving from Policy 1 to Policy 2 equal $125.00. The marginal costs to the polluter of such a move equal $75.00.\(^8^9\) Social welfare increases by the difference between the two, or $50.00. In deciding whether to move from Policy 2 to Policy 3, the economist would perform the same analysis. Moving from Policy 2 to Policy 3 would increase the breather's benefits by $75.00 but would cost ASARCO $125.00, resulting in a decrease in social welfare of $50.00. The regulator, therefore, should reject Policy 3 and select Policy 2.

If the regulator has the power to tax and subsidize as well as to regulate, any increase in total social welfare can be redistributed to increase every party's welfare. The regulator could tax the breather $76.00 of his $125.00 gain in well-being under Policy 2 and transfer the money to the firm. The breather would get $49 and the firm $1 more benefits than if there was a policy of no control. Both would be better off.

The economically efficient policy can also be determined by analyzing functions expressing the change in marginal benefits and marginal costs of removing increments of pollution.\(^9^0\) By inducing or requiring the firm to control pollution to the point where the marginal benefits of

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\(^8^7\) This assumption is clearly questionable. See infra note 179 and accompanying text.

\(^8^8\) This assumption appears reasonable in the ASARCO case, since EPA chose to require ASARCO to install a specific control technology. EPA Proposed Arsenic Standards, supra note 7, at 33,122. The cost of the installation and maintenance of the equipment would likely be largely independent of the level of output of copper from the smelter.

\(^8^9\) This assumption about costs simplifies the analysis of the impact of pollution control on output. Under this assumption, pollution control regulation acts as a lump sum tax, only causing a change in output when the tax exceeds the firm's profits and it is forced to shutdown.

\(^9^0\) For an intuitive explanation of marginal analysis, see R. STEWART & J. KRIER, supra
control equal the marginal costs of control, the regulator will maximize total welfare.

Graph 1 illustrates this point. In Graph 1, $q^*$ represents the level of emissions reduction at which marginal benefits equal marginal costs. At this point, the total net benefit to society will equal the area FGB, the difference between total benefits and total costs when $q^*$ units of emissions are removed. If $q^1$ units are removed, the total net benefits to society will equal the area FGAC, a decrease in net benefits equal to the area ABC. Similarly, if the regulator required the firm to reduce emissions from $q^*$ to $q^2$, then total net benefits would decrease by the area BDE, the amount that costs exceeded benefits of reducing emissions from $q^*$ to $q^2$.

Graph 2 illustrates the pollution control problem in terms of total benefits and total costs. Where all the functions are continuous, marginal analysis will indicate where total net benefits, the difference between total benefits and total costs, reaches its maximum. To the left of $q^*$, the total benefits increase faster than the total costs, meaning that marginal


Note that the analysis can be conducted in terms of actual emissions or emissions removed. The analysis is identical, as the two terms represent the same problem. Here the discussion will normally be in terms of emissions removed.
benefits of increased control are greater than the marginal costs. To the right of $q^*$, the total benefits increase at a slower rate than the total costs, meaning that marginal benefits of increased control are less than the marginal costs. At $q^*$ the total benefits and total costs increase at the same rate. The difference between total costs and total benefits is greatest, and, therefore, net benefits are maximized at this point.

GRAPH 2
Total Costs and Benefits

This analysis presumes the regulator achieves the economically efficient result by directly controlling the level of emissions. However, some economists have suggested that regulators achieve this result by taxing emissions. This would encourage the firm to reduce emissions. A tax on each unit of pollution in Graph 1 (above) equal to $p^*$ would lead the firm to remove $q^*$ units of emissions because the cost of removing emissions up to $q^*$ is less than the tax rate the polluter would pay on those emissions. The cost of removing emissions beyond $q^*$ is greater than the tax rate, and the firm would pay the tax $p^*$ rather than further reduce emissions. If the regulator instead selected $p^i$ as the tax on emissions, the firm would only remove $q^i$ units. Moving the tax from $p^i$ to $p^*$ would

91. See infra note 250 and accompanying text.
result in a welfare gain of ABC. A similar argument could be made for reducing the tax from $p^2$ to $p^*$. These examples have not considered that the cost of pollution control might cause the polluter to lose money at or before the economically efficient emission level is reached.\footnote{ASARCO took the position that complying with the regulations would force them to shut down. \textit{See supra} notes 75-77 and accompanying text.} For example, Table 2 shows the costs and benefits of the same policies examined in Table 1 if the firm had profits of $50.00 without any control instead of $200.00. Using the analysis from Table 1, the regulator would select Policy 2, the policy which maximizes the total societal benefits.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|}
\hline
 & Policy 1 & Policy 2 & Policy 3 \\
\hline
\multicolumn{1}{|l|}{Firm Profits} & $50.00$ & $-25.00$ & $-150.00$ \\
\multicolumn{1}{|l|}{Breather Benefits} & $0.00$ & $125.00$ & $200.00$ \\
\multicolumn{1}{|l|}{Social Welfare} & $50.00$ & $100.00$ & $50.00$ \\
\hline
\end{tabular}
\caption{Table 2}
\end{table}

However, if the regulator lacks the power to tax and subsidize, the firm would close its plant under Policy 2 because it would prefer to make no money rather than to lose money.\footnote{Introducing a shutdown point adds a non-convexity, an unsmooth jump in the costs or benefits of regulation, to the analysis. Where a non-convexity exists, economists cannot rely solely on a marginal analysis. They must also compare two or more alternatives to arrive at the optimal policy. \textit{See A. Fisher, supra} note 90, at 176-79; \textit{W. Baumol & W. Oates, The Theory of Environmental Policy} 120-23 (1976); Polinsky, \textit{Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches}, 8 J. of Legal Stud. 1 (1979).} Moreover, a shutdown might increase social costs, and thereby reduce the total benefits, of emissions control. These shutdown costs might include costs incurred by displaced workers in searching for new jobs or in emotional suffering or physical harm,\footnote{This anomalous result can be avoided if the regulator can tax the breather by at least $26 and redistribute the wealth to the firm. The firm in that case would realize a profit of $1 and stay in business. Social welfare would also be maximized.} and costs incurred by purchasers of the firm’s product who would have to seek a new supplier and might have to pay higher prices.\footnote{During the ASARCO controversy, opponents of emission reduction claimed that greater health harms would stem from increased unemployment than from allowing the smelter to continue operating. Tacoma News Tribune, Nov. 3, 1983, at A-1, col. 2.} If a shutdown imposes a cost of $100.00 on the breather, for example as the cost of searching for a new job, and if all other conditions are
the same as in Table 2, the actual choices available to the regulator are shown in Table 3. The firm profits under Policy 2 or 3 become $0 since the polluter will close and will not install any emissions control devices. On the other hand, the breather will have a net benefit of only $100 since his gain in clean air of $200 will be offset by a $100 expense in locating a new job. The regulator in this situation has two options: she can keep the firm in operation by selecting Policy 1, or she can close the firm by selecting Policy 2 or Policy 3.96 Given the values of Table 3, the regulator will select Policy 2 or 3 and close the firm, because the total net benefits are $100 under Policy 2 or 3, but only $50 under Policy 1.

<table>
<thead>
<tr>
<th>Policy</th>
<th>No Control</th>
<th>50% Control</th>
<th>100% Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm Profits</td>
<td>$50.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Breather Benefits</td>
<td>$0.00</td>
<td>$100.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>Total Social Welfare</td>
<td>$50.00</td>
<td>$100.00</td>
<td>$100.00</td>
</tr>
</tbody>
</table>

If the costs imposed by the shutdown were not $100 but were greater than $150.00, the total benefits of Policies 2 and 3 would fall below $50 and the regulator would select Policy 1. The regulator's choice thus turns on the relationship between the benefits of complete emission elimination and the costs of a plant closure.

The choices available to the regulator can also be represented graphically. In Graphs 3A and 3B, the total benefit function behaves in a normal manner from I to A; that is, it behaves normally up to the point where the firm must shutdown, $q^{max}$. If a firm could stay in business beyond $q^{max}$, for example because the regulator could subsidize the firm for emissions removed beyond that point, the total benefit function would continue to increase from A to B, as indicated by the dashed line. Therefore, if the regulator closes the firm, the breathers will gain the air pollution benefits represented by BF. However they will also suffer a loss represented by BD, due to unemployment caused by the plant closure. Thus DF represents the total benefits the breathers would obtain in the event of plant shutdown.

96. There is no difference between Policy 2 and Policy 3. Both result in the shutdown of the smelter and in the breather bearing job search costs but no pollution costs.
In Graphs 3A and 3B, the total cost abatement function behaves in the normal manner from I to C. The function indicates that the firm's total expenditures increase as the amount of pollution removed increases. At point C, the expenditure on pollution control equipment equals the amount by which the profits of the present use of the plant (smelting copper in the ASARCO case) exceed the profits of the firm's next best
use of the plant. When the required pollution control expenditures exceed the potential profits, the firm will move to the second best use of the plant. The second best use might be to close the plant. Any control requirement beyond \( q_{\text{max}} \) will not increase expenditures on pollution control equipment because the firm will switch the plant to another use. The total costs will not fall to zero, because the firm incurs the loss of the additional profits it could have made using the factory in its most productive use. In the event of a plant shutdown, the firm’s costs will be represented by \( EF \), and total societal net benefits will equal \( DE \).

If achieving the optimal level of emissions removal, \( q^* \), requires a plant to remove emissions beyond its shutdown point, \( q_{\text{max}} \), the polluter will close his plant. In Case 1, depicted in Graph 3A, the regulator has two options: she can control emissions up to point \( q_{\text{max}} \), or she can close the plant by requiring more stringent controls. The regulator should compare the difference between total costs and total benefits under the two options and select the option that maximizes the difference. In Graph 3A, this requires the regulator to compare segment \( AC \) (total societal benefits at \( q_{\text{max}} \)) with segment \( DE \) (total societal benefits with shutdown). If segment \( AC \) is greater than \( DE \), the regulator should control emissions to \( q_{\text{max}} \). If segment \( AC \) is smaller than \( DE \), the regulator should close the plant.

On the other hand, in Case 2, depicted in Graph 3B, the optimal point, \( q^* \), occurs at a level of control the firm can afford. The regulator again has two options: she can control emissions up to point \( q^* \), the level of control that provides the greatest net benefits without shutdown\(^97 \) or she can require control beyond \( q_{\text{max}} \), closing the plant.\(^98 \) In Case 2, the regulator must compare segment \( GH \) with segment \( DE \). If segment \( GH \) is smaller than \( DE \), the regulator should close the plant, because total societal benefits would be greater than if the plant remained in operation.

### B. Health Effects Based Regulation

The extreme alternative to setting standards for emissions on a cost-benefit basis is to set standards whose sole consideration is to protect the population from adverse health effects of emissions. This approach, the health-only approach, would ignore any economic impact. Several justifications have been offered for setting hazardous air pollutant standards on this basis.

First, the language of the statute requires the Administrator to es-

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97. Where a non-convexity exists it is necessary to look at the extreme solutions regardless of whether the internal maximum is achieved. W. BAUMOL & W. OATES, supra note 92, at 122. This means that in Graph 3B the result must be checked at two points: \( q^* \) and shutdown (any point beyond \( q_{\text{max}} \)).

98. Segment \( GH \) will axiomatically be greater than segment \( AC \). See supra text discussion of Graph 2.
establish "standard[s] at the level which in his judgment provides an ample margin of safety to protect the public health." Several courts have interpreted similar language in other statutes to require EPA to consider only health effects in passing regulations.

The second justification is that Congress intended the law to protect the public health by requiring EPA to select an emissions level below the threshold level. The "ample margin of safety" language of section 112 of the Clean Air Act reflects this intention. In a summary of the Conference Report on the Act, Senator Muskie, the chief author of the Clean Air Act, wrote: "The standards must be set to provide an ample margin of safety to protect the public health. This could mean, effectively, that a plant would be required to close because of the absence of control techniques. It could include emission standards which allowed for no measurable emissions." Senator Muskie clearly did not view the choice as one involving balancing of the costs and benefits of control. Rather, he believed that EPA should select a safe emission level.

The third justification, developed from an analogy to antitrust law, is that it is the most efficient policy. Under this analogy, a per se rule prohibiting a regulator from balancing the costs and benefits of hazardous air pollution should be adopted if the benefits of control generally outweigh the costs associated with control, and if it is difficult or impossible to distinguish the general case from the exceptional cases. If the second condition is not met, the regulator should consider costs and benefits since savings could result from distinguishing the exceptional cases.

C. A Suggested Approach to Regulating Hazardous Air Emissions

1. Reject Health-Only Approach

While the language of section 112 presents a strong legal argument for a health-only approach to regulating hazardous air pollutants, the two policy justifications fail to support such an approach.

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100. See Doniger, supra note 19, at 570.
101. The threshold level is the level of emissions below which few, if any, health harms occur. A regulator under this theory should regulate emissions so that pollution concentrations remain just below the threshold level. Since no health harm occurs below the threshold level, the public is safe.
104. Doniger, supra note 19, at 656-57.
105. Id. at 656.
106. Id. at 657.
The argument that Congress intended section 112 only to protect health assumes that health effects begin at some threshold level of emissions. In 1970, when it passed the Clean Air Act, Congress seems to have believed in the existence of thresholds. Yet, since 1970, the scientific community has widely discredited the threshold theory. A 1974 National Academy of Sciences study concluded, "[e]vidence indicates that the amount of health damage varies with upward and downward variations in the concentration of the pollutant, with no sharp lower limit." A House report later conceded that the threshold concept was "at best, [a] necessary myth to permit the setting of some standards." Since the theory underlying Congress' intent has been discredited, EPA and the courts should not continue to rely on that theory as the basis for adopting a health-only approach.

The third justification for a health-only approach, the per se analogy, offers a more plausible basis for adopting this approach. However, the two conditions for using a per se approach are not satisfied in the emission regulation setting. The first condition, that the benefits of controlling hazardous air pollutants generally outweigh the costs of shutdown, is not clearly met. While in some cases the benefits of banning hazardous air pollutants are likely to outweigh the costs, there are also cases where this is not likely to be true. Where significant plant shutdowns result from regulation, it is particularly unlikely that the benefits will generally outweigh the costs, because such shutdowns impose significant costs.

The second condition, an inability to distinguish between those hazardous air pollutants for which the benefits of control outweigh the costs, the assumed case, and those hazardous air pollutants for which the costs outweigh the benefits, the assumed exceptional case, is also not satisfied. While the estimation of benefits and costs is imprecise, it is apparent that some chemicals are more likely to cause a large number of

107. See supra notes 101-03 and accompanying text.
111. Of course the opposite presumption, that the costs outweigh the benefits could be made. However, the health-only approach assumes the benefits outweigh the costs.
113. Clearly the shutdown of the ASARCO smelter imposed significant costs, including the loss of 800 jobs. EPA Proposed Arsenic Standards, supra note 7, at 33,131.
114. See infra notes 164-79 and 231-35 and accompanying text.
cancers than others. Since the harms associated with pollutants can be distinguished, the second condition for the use of the per se approach is also not met. This failure to meet the two conditions of the per se approach suggests the need for "honest, complex balancing decisions." In addition to lacking a convincing justification, the health-only approach leads to a number of problems. First, once one assumes that emissions have no threshold levels, regulating emissions at a level that allows no public health harm would require closing whole industries. This result, on balance, would not benefit society and could not be carried out politically. Second, as a practical matter, attempts to force EPA to promulgate regulations without considering the costs of meeting the regulations have resulted in ad hoc consideration of the costs and benefits by courts. Courts lack the expertise and resources to make these decisions. Third, failure to allow EPA to consider costs and benefits when developing regulations may lead to irrational regulation. Requiring EPA to regulate on a health-only basis leaves the Agency open to political manipulation, because it deprives it of a rational basis for regulation. Explicit consideration of costs and benefits might help EPA avoid political manipulation, by allowing the Agency to view regulation as a scientific problem.

2. Adoption of Cost-Benefit Approach

EPA should in fact go beyond its present approach of determining BAT and then weighing the costs and benefits to determine if the plant should be shut, and adopt a more comprehensive economic approach. EPA's arsenic standards have been heavily criticized by the Office of Management and Budget (OMB). OMB's criticism centers on EPA's separate regulation of different arsenic-emitting industries and on its lack of regard for differing marginal costs of achieving equivalent health benefits. The proposed regulations require low-arsenic smelters and glass

116. See Doniger, supra note 19, at 657. Other experts also advocate a balancing approach. See NAT'L ACADEMY OF SCIENCES, supra note 112, at 20; Portney, supra note 112, at 119; L. LAVE, supra note 115, at 8.
118. See id. at 387-89.
119. The regulation of arsenic emissions provides an illustration of the problem. To meet the proposed standards, low arsenic smelters must spend far more per cancer avoided than would the ASARCO smelter. See OMB Position, supra note 79, at 1595 table 1.
120. See B. ACKERMAN & W. HASSLER, CLEAN COAL/DIRTY AIR 117-21 (1982). Ackerman and Hassler describe the political influence EPA was subjected to in writing emissions regulations for coal fired power plants. Id. at 79-103. They contend that an expert agency given authority to weigh costs could have come to a more rational decision. Id. at 118-19.
121. EPA Administrator Ruckelshaus has also suggested this approach. See Ruckelshaus Statement, supra note 3, at 40.
122. See OMB Position, supra note 79, at 1594.
123. Id. at 1594-95.
manufacturers to spend far more than ASARCO to eliminate each cancer at the margin. The public health gains, in terms of cancers avoided, range from 2.0 to 0.001 cancers avoided per million dollars spent. To return to Graph 1 (above), EPA's proposed arsenic regulations, which do not consider cost and benefits in setting BAT, require some firms to reduce emissions to the $q^*$ level, some to $q_2$, and others, perhaps, to $q^*$.

OMB's criticism ignores the fact that certain control levels will cause some firms to close. The possibility of shutdown accounts for some of the divergence between the marginal value of dollars spent on reducing emissions. Returning to the analyses of Case 1 and Case 2 in Graphs 3A and 3B (above), one can see the social welfare loss associated with EPA's approach. If Case 1 applies (Graph 3A, above), the firm cannot afford to remove $q^*$ units of pollution, and EPA's approach will produce the efficient result given the no subsidization constraint. If Case 2 applies (Graph 3B, above), however, the firm can afford to remove $q^*$ units of pollution, but EPA under its present approach requires greater control and thus an inefficient result. This inefficiency results for two reasons. First, if the plant is not closed under the EPA approach, inefficiency occurs because removing emissions beyond $q^*$ produces social costs greater than the social benefits generated. The area BDE in Graph 1 (above) illustrates the loss associated with EPA's approach. Second, as Graph 3B (above) illustrates, EPA's approach might lead to closure when closure should not occur if the net benefits at $q_{max}$ are less than the net benefits of shutdown while the net benefits at $q^*$ are greater than the net benefits of shutdown.

The use of cost-benefit analysis for regulating hazardous emissions has been criticized. Many critics contend that EPA lacks the information required to carry out a cost-benefit analysis. While information on the costs and benefits is uncertain, any balancing decision requires EPA to explicitly or implicitly estimate and value the costs and benefits. Furthermore, EPA already develops much of the necessary information when it calculates the effects of various control levels.

Critics also contend that a cost-benefit analysis neglects many of the benefits of emission control, such as reduction in morbidity levels and

124. *Id.* at 1595.
125. Given the possibility of shutdown and EPA's inability to redistribute benefits, there will be situations where the regulator seeking to maximize social welfare should not select emission level $q^*$. See *supra* notes 93-98 and accompanying text.
126. EPA's approach requires control up to $q^2$. See * supra* notes above.
127. There are two types of information problems. The first problem involves forecasting the effects of a policy. The second involves the valuation of the effects. See Baram, *Cost-Benefit Analysis: An Inadequate Basis for Health, Safety, and Environmental Regulatory Decisionmaking*, 8 ECOLOGY L.Q. 473, 482-86 (1980).
128. See *OMB Position*, *supra* note 79, at 1600. OMB performed a cost-benefit analysis of the arsenic standards using data generated by EPA. Others have completed similar cost-benefit efforts. *Benefit-Cost Analysis*, *supra* note 18, at 407-18.
improvement in worker health. Clearly EPA should consider such benefits in its analysis, and any statute or regulations explicitly adopting a cost-benefit approach for section 112 should require that EPA consider these and other benefits.

Some critics contend that EPA could manipulate cost-benefit analyses to increase Agency discretion. There are several arguments against this criticism. Under either the cost-benefit approach or the BAT approach, the Agency has some discretion over the assumptions it uses in making its determinations. Congress can control discretion under the cost-benefit approach in two ways. First, Congress can specify the assumptions the Agency must use in formulating its estimates. For example, Congress might require that the Agency use a no-threshold linear model to estimate cancer dose-response rates. Alternatively, Congress could control Agency discretion more generally by requiring the Agency to make assumptions that tend to increase the benefits attributed to control where uncertainty exists. Such assumptions will be termed "conservative" assumptions in this Comment.

Overall, adopting the cost-benefit approach to regulating emissions would probably lead to a more careful balancing of benefits and costs and ultimately more rational regulation. The problems associated with cost-benefit analysis appear manageable with precise statutory guidance.

D. Application Of The Cost-Benefit Approach To ASARCO

The first step in applying the cost-benefit analysis outlined here to the ASARCO case is to determine whether the level of control that would cause the plant to close \((q_{\text{max}})\) is less than (a Case 1 situation) or greater than (a Case 2 situation) the optimal level of control \((q^*)\). EPA's proposed controls would increase ASARCO's annual costs by $1.5 million and would reduce annual expected cancers by three. Each mil-

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130. See, e.g., Baram, supra note 127, at 489-90. A related problem is the ability of EPA to thwart policy through inaction. This problem can occur under any approach. A statute needs to contain language that enables outside parties to force EPA action. See B. ACKERMAN & W. HASL, supra note 120, at 121-28.
131. T. GREENWOOD, KNOWLEDGE AND DISCRETION IN GOVERNMENT REGULATION 249 (1984). In designating BAT, the Agency can employ various assumptions to determine what technology is available. See R. STEWART & J. KRIER, supra note 86, at 371-73.
132. For a consideration of such an approach, see Baram, supra note 127, at 527-31.
133. A dose-response rate indicates the number of incidents of a particular response at a given exposure level.
134. See Baram, supra note 127, at 528. This alternative would provide courts with a basis for reviewing administrative determinations. The National Academy of Sciences has suggested that "[C]ongress should provide increased and consistent statutory guidance as to the relative importance that should be given to health, environmental, and economic factors in regulating chemicals." NAT'L ACADEMY OF SCIENCES, supra note 112, at 20.
135. OMB Position, supra note 79, at 1595.
136. Id.
lion dollars spent, therefore, would avoid two lung cancers per year.\textsuperscript{137} Disregarding additional likely health benefits\textsuperscript{138} but employing “conservative” assumptions, the marginal benefits of reducing emissions up to EPA’s proposed standards are greater than the marginal costs of the reduction.\textsuperscript{139} ASARCO could not afford the proposed controls, however, let alone additional controls. This, therefore, appears to be a Case 1 situation.

The next step EPA should employ is to compare the total net benefits under the proposed standards with the total net benefits if ASARCO closed the smelter. If the marginal benefits of closure, beyond the benefits generated by regulation at the best level ASARCO can afford, are greater than the costs associated with shutdown, EPA should close the plant. In the ASARCO case, closure would result in an expected decrease of two additional, or five total, lung cancers per year.\textsuperscript{140} Additional health and environmental benefits, including a reduction in other pollutants, would also stem from the closure. The cost of closure includes the loss of approximately 800 jobs in the Tacoma area.\textsuperscript{141} The cost of that loss could vary greatly depending on how quickly those workers could find new employment, although EPA made no attempt to estimate the unemployment period. The cost associated with lost jobs might be reduced if the workers would lose their jobs even without regulation. Given the depressed state of the copper industry, it is likely that workers at the ASARCO-Tacoma smelter would have lost their jobs even if EPA had taken no action.\textsuperscript{142} Under these circumstances, where two additional lung cancers per year would be avoided, and it is likely that the jobs would have been lost anyway, EPA should have closed the plant.

IV
PUBLIC PARTICIPATION IN ENVIRONMENTAL DECISIONS

The regulation of arsenic emissions from the Tacoma smelter presents a second issue—the extent to which the public should participate in environmental decisions. In particular, the situation provides a

\begin{footnotes}
\item[137] Id.
\item[138] See supra text accompanying notes 129.
\item[139] Although a dollar value may be established for the cancers avoided, studies indicate that a wide range of values exists; $500,000 falls at the low end of the range of estimates. See infra note 179 and accompanying text. Therefore if “conservative” values are employed, the benefits of control will likely outweigh the costs of control.
\item[140] OMB Position, supra note 79, at 1595. The range EPA estimated was from 0.2 to 3.4 cancers per year. EPA Proposed Arsenic Standards, supra note 7, at 33,123.
\item[141] EPA Proposed Arsenic Standards, supra note 7, at 33,131.
\item[142] Many copper workers have been laid off recently due to the “sluggish domestic copper market.” N.Y. Times, Mar. 22, 1985, at 9, col. 1. For a detailed analysis of the difficulties faced by the U.S. copper industry, see EPA BACKGROUND INFORMATION, supra note 8, at 7-1 to 7-38.
\end{footnotes}
framework for examining the proper extent of public participation in decisions concerning tradeoffs between carcinogenic emissions and plant shutdowns.

EPA Administrator Ruckelshaus proposed giving the people of Tacoma a significant voice in deciding whether the benefits of closing the ASARCO smelter outweighed the costs. Ruckelshaus' proposal called for Tacoma residents to register their opinions through a type of ad hoc voting scheme rather than through the marketplace. The EPA proposal raises two central questions. Should the decision to close a plant producing hazardous emissions be made inside or outside the marketplace? If the decision should be made outside the marketplace, should the decision be made by the public or by experts?

A. Making the Decision Through the Marketplace

Several writers have advocated that health and safety decisions be made in the marketplace. They claim that freeing individuals to select the outcome that is best for them results in the most efficient outcome. Under this theory each individual will select the risk and benefit combination that is best for herself. The aggregate selection reflects the overall combination with the maximum social utility.

In the ASARCO case, the market consists only of ASARCO and those who buy copper. By determining the amount of copper that ASARCO produces, copper buyers determine the amount of arsenic the smelter will emit. Yet Tacoma residents, who are not in the copper market, bear the pollution costs of ASARCO’s copper production and re-

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143. See EPA Press Release, supra note 58.
144. See supra note 59-65 and accompanying text.
145. See, e.g., Buchanan, In Defense of Caveat Emptor, 38 U. CHI. L. REV. 64 (1970). Buchanan argues that decisions about product safety should be left to the market, so that individuals can select the price-risk combination that suits them. Id. at 67. See also W. VISCUSI, RISK BY CHOICE (1982). Viscusi advocates using the market approach for worker health and safety decisions. Viscusi argues that the government’s role should generally be limited to providing workers with information about risks. Id. at 156-58. Once informed, workers could make rational decisions based on the wage offered and the risks involved. Id. at 157-59. Jobs which involve higher risks would command higher wages to compensate workers for the additional risks. Id. at 37.
146. Viscusi states, “An effective risk information strategy will enable workers to be matched efficiently to jobs so that risks will fully reflect the values these workers place on their well-being and costs to employers of ameliorating the hazard.” W. VISCUSI, supra note 145, at 158.
147. For Viscusi’s market scheme to operate effectively, workers and potential workers must have access to information, properly evaluate that information, and have a range of options with different risks available. Viscusi concedes that some government intervention could be justified in the case of health risks since these risks pose particularly difficult problems of risk evaluation. Id. at 160. Other analysts have questioned each of Viscusi’s assumptions. See Cornell, Noll & Weingast, Safety Regulation, in Setting National Priorities: The Next Ten Years 464 (W. Owen & C. Schultze eds. 1976).
receive no compensation. Economists call such costs externalities.\textsuperscript{148}

When outsiders bear the cost of externalities without compensation, the producer does not bear the full cost of production. Overproduction and inefficiency result.\textsuperscript{149} Overproduction occurs when the social benefit of the good produced falls below the social cost of producing the good.\textsuperscript{150} Society loses on every good produced where the social benefits fall below the social costs. Graph 4 illustrates this loss. Assuming the demand curve accurately represents the marginal benefits to society of each unit produced, the firm will produce up to $q^2$, the point where the demand curve and the firm's marginal cost curve intersect, since this will maxi-

\textbf{GRAPH 4}

\textit{The Cost of an Externality}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{externality_graph.png}
\end{figure}

\begin{itemize}
\item \textsuperscript{148} See, e.g., J. Hirshleifer, \textit{supra} note 82, at 449.
\item \textsuperscript{149} There are also positive externalities, unpaid for by-products which benefit parties who do not pay for the benefits. Where a positive externality exists, underproduction occurs.
\item \textsuperscript{150} The social benefit of a good is the value to the consumer who consumes it and others who benefit by its consumption. The social cost is the production cost plus the external costs imposed by the good's production and consumption.
\end{itemize}
mize the firm's profits. The social cost of producing all the units from \( q' \) to \( q^2 \) exceeds the social benefits of producing those units, and as a result society loses on the production of all units between \( q' \) and \( q^2 \). The loss to society is represented by the area ABC.

Some argue that the externality problem need not lead to abandonment of market decisionmaking. They suggest that it may be possible to remedy the problem by assigning property rights to the air and setting up a means of enforcing those rights. A regulator could assign those rights in one of two ways. Either the polluter could be given the right to pollute, or the breather could be given the right to breathe clean air. The party without the air rights could then buy the air rights from the other party if she valued them more highly.

Even if air rights were assigned, however, imperfections in the pollution market would still cause an inefficient allocation of resources. For example, assigning the air rights to polluters would lead to pollution at the level that maximizes profits because three factors block breathers from purchasing pollution rights. Poor information forms the first barrier to the formation of a market. Breathers frequently can neither get nor understand important information related to emissions regulation. For example, individuals cannot detect the slight increase in cancer caused by arsenic emissions. The only way for individuals to obtain this information would be for the government to provide it. This is problematic because estimates of cancer risk are highly imprecise, and be-

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152. A regulator could also assign intermediate rights, but this Comment considers only the two extremes. These entitlements could be enforced either by injuction or by compensatory damages. An entitlement enforced with an injuction allows one party to force the other party to cease operations if the conditions of the entitlement are not satisfied. However, the party holding the entitlement may sell it to the other party. A damages remedy allows a party to collect money for the harm caused by violation of the entitlement. For a discussion of damages remedies and injuction remedies, see Boomer v. Atlantic Cement Co., 26 N.Y.2d 219, 257 N.E.2d 870, 309 N.Y.S.2d 312 (1970) and A. Polinsky, supra note 151, at 18-20. An entitlement held by the breathers enforced with a damage remedy is identical to a Vickrey auction. See infra notes 251-55 and accompanying text. Like a Vickrey auction, a damages remedy can overcome problems of strategic behavior and transaction costs. A. Polinsky, supra note 151, at 18-20. To overcome these problems, the court must set damages equal to or less than actual damages at pollution levels below the optimal level and greater than actual damages at pollution levels greater than the optimal level. Id. at 20. This requirement places a severe information burden on a court, which it would probably be unable to satisfy.

153. For a general discussion of the potential problems, see A. Polinsky, supra note 151, at 18-23.


155. For example, EPA's estimate of cancers caused by the ASARCO smelter before con-
cause breathers may not base their estimates of the cancer risk associated with a given level of emissions on the government's information.\textsuperscript{156}

Transaction costs form a second barrier to the formation of a market. It is costly for a large number of breathers to form individual contracts with a polluter. For example, in the Tacoma area over 300,000 people breathe the arsenic emitted from the ASARCO smelter. In order to induce ASARCO to reduce pollution, all the residents would have to agree on an amount to pay ASARCO. Contacting all 300,000 people and measuring individual opinions would require considerable time and money. These transaction costs might be greater than any gains stemming from trading air rights and therefore might block such trades.\textsuperscript{157}

For example, if the total benefits to the residents of reducing arsenic emissions from \( q' \) to \( q'' \) in Graph 1 (above) equaled $3 million, and the total cost for ASARCO to reduce these emissions equaled $2.5 million, then, under the market model, ASARCO would agree to remove \( q'' \) units if the residents paid it some amount between $2.5 and $3 million. If, however, the residents had transaction costs of $600,000, they would only be willing to pay ASARCO $2.4 million to reduce its pollution. ASARCO would not be willing to remove \( q'' \) units for $2.4 million as it would cost the company $2.5 million to remove that many units of emissions. Transaction costs, then, could prevent market exchanges.

Strategic behavior among breathers forms a third barrier to the formation of a market.\textsuperscript{158} In order to reach an agreement with ASARCO, the breathers would have to agree jointly to pay the company. Each individual would benefit from the reduction associated with everyone else's payment to ASARCO.\textsuperscript{159} However, each person might try to have others pay for the reduction in air pollution by pretending she values clean air very little, and thus attempting to "free ride" on the payments of others to ASARCO.\textsuperscript{160} This free rider problem could block any attempts to make a collective decision.\textsuperscript{161}
These three barriers would impede and likely block the development of a market in arsenic-free air if ASARCO were assigned the entitlement. Instead, ASARCO would pollute at its profit maximizing rate, with no limitations on its actions.\(^{162}\) The ASARCO case supports this conclusion. ASARCO was in effect assigned the entitlement in the days before regulation. No market in arsenic-free air developed. ASARCO therefore polluted at the rate that maximized its profits.

On the other hand, if a regulator assigned the air rights to the breathers, similar transaction costs and strategic behavior among breathers would again probably prevent a market for pollution rights from forming.\(^{163}\) ASARCO would not be able to purchase pollution rights, and no smelting would take place.

This analysis suggests that a market mechanism will not reach the efficient outcome regardless of which party is assigned the air rights. To achieve the efficient outcome, it is necessary to turn to nonmarket mechanisms, as Congress required in section 112 and as EPA did in the ASARCO case.

### B. Nonmarket Expert versus Nonmarket Public Decisionmaking

#### 1. Uncertainty in Decisionmaking

In a nonmarket setting, decisions about emission levels can be made either by experts or by the public, or by a hybrid approach. Such decisions should be made by the party who can most readily estimate the optimal level of pollution control. In determining this optimal level, the decisionmaker must compare the health benefits of a reduction in emissions to the costs. Any estimate of health benefits, however, is fraught with uncertainties\(^{164}\) and requires five difficult steps.\(^{165}\) The relative abilities of expert and public decisionmakers to make decisions about emission levels can be compared by examining their respective abilities to resolve the possible uncertainties at each step in the decisionmaking process.

First, in estimating the benefits of an emission reduction the deci-

\(^{162}\) Latin analyzes several ways environmentalists might serve as middlemen to help develop a market. He rejects all such schemes as impractical. Id.

\(^{163}\) See, e.g., Boomer v. Atlantic Cement Co., 26 N.Y.2d 219, 257 N.E. 870, 309 N.Y.S.2d 312 (1970). The court opted for a damage remedy, because it feared that an injunction would lead to closure of the plant. The court appeared to fear that transaction costs or strategic behavior would prevent market exchanges from taking place.

\(^{164}\) For a discussion of the difficulties in estimating the health benefits of an emission reduction, see, e.g., R. CRANDALL & L. LAVE, supra note 154, at 3-13; Doniger, supra note 19, at 508-14; Latin, The "Significance" of Toxic Health Risks: An Essay on Legal Decisionmaking Under Uncertainty, 10 ECOLOGY L.Q. 339 (1982).

\(^{165}\) These five steps can be collapsed into fewer steps. See M. FREEMAN, THE BENEFITS OF ENVIRONMENTAL IMPROVEMENT 17 (1979) (three "functional relationships"); Benefit-Cost Analysis, supra note 18, at 40 (four relationships).
sionmaker must estimate the rate of emissions with and without controls. While in theory this appears to involve a straightforward calculation, such estimates in fact are often inaccurate. For example, EPA lowered its original estimates of ASARCO's arsenic emissions.

Second, a decisionmaker must determine the emissions dispersal pattern, which is usually expressed in terms of the ambient air concentration of a pollutant at a given place. Pollution dispersion models used for this task suffer from considerable uncertainty. For example, predicted concentrations of arsenic tend to overstate actual concentrations, indoor concentrations of an emitted pollutant differ from outdoor concentrations, and the extent to which emissions settle in the soil is uncertain.

Third, the decisionmaker must determine the extent and duration of human exposure to emitted pollutants. This task also poses problems. For example, in deriving its arsenic exposure estimates, EPA assumed that individuals remain in a single location and, as a result, suffer a constant rate of exposure. This assumption is frequently inaccurate since people work in different locations, spend considerable time indoors, and may move during their lifetimes.

Fourth, the decisionmaker must estimate the relationship between the level of exposure and the rate of cancer or other harms. This often poses the greatest difficulty to administrative agencies that regulate harmful chemicals. Generally, the decisionmaker must "guess" at the relationship between exposure levels and cancer by extrapolating from the results of studies of the effects of exposure to high pollutant concentrations to estimate the effects of exposure to low pollutant concentrations. For example, in the ASARCO case, EPA used a linear, no-threshold model to extrapolate its estimate of the cancer risk on the population at large from cancer rates observed in workers exposed to high levels of arsenic at their jobs. In addition, the decisionmaker must often extrapolate from animals to humans as well as from high doses to

167. See supra notes 73-74 and accompanying text.
169. EPA Proposed Arsenic Standards, supra note 7, at 33,131.
170. For a brief discussion of indoor air pollution, see Benefit-Cost Analysis, supra note 18, at 421.
171. EPA BACKGROUND INFORMATION, supra note 8, at E-29.
172. EPA Proposed Arsenic Standards, supra note 7, at 33,115. EPA used the 1970 census to determine the location of individuals. Id.
174. Id. at 422-25.
176. EPA Proposed Arsenic Standards, supra note 7, at 33,114, 33,131. The linear no-threshold model assumes cancer rates rise in proportion to the level of exposure.
Finally, the decisionmaker must value the effects of a reduction in emissions in order to compare these benefits to the costs of reduction and to decide on a level of emissions. Even if the decisionmaker fails to value the effects of a reduction explicitly, she does so implicitly when she chooses whether to reduce emissions. For example, if the regulator decides to reduce emissions, she has implicitly decided that the positive effects of a reduction outweigh the negative effects. If the decisionmaker values the effects explicitly, she must determine the basis for the making the explicit valuation. Often regulators try to base their valuation on the value that the public assigns to these positive effects, but government estimation of these public values also creates uncertainties.

The regulation of arsenic emissions from the ASARCO smelter illustrates the difficulty EPA has in valuing the health benefits of reduced emissions. Even if, as EPA assumed, the only benefit to closing the plant is a decrease of an additional two cancers per year, and the only costs of closure are the job search costs, moving costs, and emotional costs of the 800 displaced workers, EPA still must decide if the benefits of two fewer cancers outweigh the significant costs associated with a shutdown.

2. Critique of Expert Decisionmaking

The expert decisionmaker faces more uncertainty than the public in determining how to value the effects of an emissions reduction. First, if the expert decisionmaker elects to value the effects as the public does, she must determine the value the public places on the effects. Procedures for estimating public values often lead to widely differing results.

The threat of agency "capture" poses a second problem in relying on expert decisionmakers. The "capture" theory states that those groups most concerned with a specific body of regulation will come to dominate the relevant regulatory agency. The heavy impact of regulation on these groups leads them to participate in functions of the regulatory body, whereas others, on whom the effects are more diffuse, remain apathetic. Both the courts and Congress have attempted to limit the capture problem at EPA. In environmental statutes, Congress generally requires EPA to pursue specific goals or to use specific means, thus limiting the

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177. L. LAVE, supra note 115, at 43. Often, the only studies that link a substance to cancer are laboratory studies on animals exposed to high concentrations of the substance.


179. Id. For example, estimates of the values that individuals place on their own lives vary markedly. See, e.g., A. FISHER, supra note 90, at 212. Estimates in this study vary from $28,000 to $5,000,000. Id.

180. See supra notes 140-41 and accompanying text.

181. See supra note 179.

discretion of the Agency and the possibility of capture. Some circuit courts, the District of Columbia Court of Appeals in particular, have actively reviewed environmental regulations, in part because of concerns over capture. The active role the courts have taken in forcing and reviewing EPA action under section 112 suggests that the courts have mitigated capture problems in this situation.

3. Critique of Public Decisionmaking

A decisionmaking procedure that relied completely on the public to determine the level of emission reductions would fail to produce rational results. Because of its lack of expertise, the public is unable to perform the first four steps necessary to a rational estimation of the benefits of an emissions reduction. Thus any public decision would not reflect scientific estimates of the effects of a reduction in emissions.

In addition, a public decisionmaking approach would make it easier for a regulated firm to engage in strategic behavior. Since the public has neither the expertise nor the resources to assess or check the reliability of information provided by a firm, a firm might find it easier to deceive the public than the expert regulator.

Public decisionmaking creates further problems. Geographically limited voting may exclude some concerned people. For example, both the benefits and costs of closing the ASARCO-Tacoma plant extend beyond the Tacoma area. Some people outside the area might face higher copper prices, and firms that supply the smelter might face reduced business. On the other hand, shifting capital and future investment to another location as a result of the closure could benefit that region. The effect of excluding these affected, but geographically distant, people from the decisionmaking process is unclear.

Public decisions concerning arsenic emissions may not adequately consider the harm caused to future generations. Yet a decision by this generation to keep the smelter open will probably affect the next generation since arsenic emitted from the smelter may persist in the soil.

Assuming the public understands all the costs and benefits associated with the alternatives, and assuming all those with a stake participate, a voting mechanism may still fail to accurately measure the strength of parties' preferences and may thus still lead to an improper
outcome.\textsuperscript{189}

One way to measure the public's preference is to use a voting scheme based on a unanimity rule. This entails finding a solution to which all parties agree. Such agreement might be obtained by compensating individuals for losses they suffer. However, given the two alternatives that EPA framed in the ASARCO case, BAT or shutdown, a unanimity rule would fail. Those who benefit from cleaner air, the breathers, have an incentive to block the first alternative, and the workers, who bear the burden of the shutdown, have an incentive to block the second alternative. Transaction costs and the free rider problem would prevent the compensation necessary for either group to remove its incentive to block the other,\textsuperscript{190} and unanimity thus would never be achieved.

Another way of testing popular preference is by a majority rule. While a strong argument can be made that certain decisions should be made using the majority rule regardless of the economic effects,\textsuperscript{191} the rule will be analyzed from the economic perspective here. Perhaps the fact that the problem of evaluating the benefits of an emissions reduction stems from market failure justifies the economic approach. Under the proper conditions, the majority rule can measure the strength of preference as well as the direction of preference.\textsuperscript{192} The key condition is that those who prefer each outcome must be willing to pay the same amount to have their outcome occur.\textsuperscript{193} If this condition is not satisfied, however, the results of voting will be skewed by the concentration of benefits and costs and by the costs of participating in the election. In the ASARCO case, the key condition would probably not be met,\textsuperscript{194} and the results of a majority vote, therefore, would be skewed.

Under the majority rule, if the cost of participating is zero, the side whose benefits are spread out over the largest number of individuals will be favored regardless of the relative strengths of the preferences on each side. In the ASARCO case, the benefits of a shutdown are spread over a larger number of individuals than the costs.\textsuperscript{195} Thus under a voting mechanism where there are no costs to participating, shutdown would be favored. This result, however, does not account for the strength of society's preference and skews the result.

\textsuperscript{189} The proper outcome is the outcome that maximizes the total well being of society. Some commentators believe elections serve other goals besides achieving the proper outcome. See, e.g., A. Okun, \textit{Equality and Efficiency: The Big Tradeoff} (1975).


\textsuperscript{191} See A. Okun, \textit{supra} note 189 at 6-12.

\textsuperscript{192} D. Mueller, \textit{supra} note 190, at 210-12.

\textsuperscript{193} \textit{Id}. at 211-12.

\textsuperscript{194} Presumably the workers who would lose their jobs would be willing to pay more to vote than the breathers.

\textsuperscript{195} All of the 300,000 individuals living around the smelter derive benefits from closure. The costs fall primarily on those 800 individuals who will lose their jobs in a shutdown and their families.
A high cost of participating in the voting scheme may also skew the result. If the cost of voting is high, those who have a strong interest in the matter will be more likely to participate than those who do not. The costs of participating in the ASARCO voting were high. EPA required voters to attend a meeting to speak out for their positions or to fill out a public comment form. Since individuals with jobs at stake would be more likely to participate than members of the public concerned with clean air, this procedure should have favored continued operation. However, the results of the Baird survey do not support this hypothesis.

One possible remedy for the strength of preference problem would be to simply ask individuals to state their strength of preference. This however invites individuals to overstate the strength of their preference to increase the likelihood that their side will prevail.

Economists have designed more complicated voting schemes that attempt to determine true strength of preference by taxing individuals based on their responses. Since overstatement leads to a higher tax without a corresponding benefit for the individual, the tax makes overstating preferences disadvantageous. Such schemes suffer from two flaws. First, they are complicated and are difficult to administer in a real world setting. As an individual's tax depends on his response, each tax would have to be determined separately. The administrative expense would be considerable. Second, these voting schemes may discourage participation as the cost of participation is increased.

4. EPA's Hybrid Decisionmaking Method

One answer to some of the above problems is to have an expert agency provide the public with information generated during the first four steps in evaluating the health benefits of an emissions reduction. The public could then decide how to value the benefits and costs, and how to make the tradeoff between the positive and negative effects of an emissions reduction, based on the government's information. This was EPA's approach in the ASARCO case. EPA attempted to limit public participation to the fifth step, and to have the public rely on EPA determinations from the first four steps. As EPA structured the choice, the area residents could have chosen to control arsenic emissions at the level of the proposed standard or to close the plant.

In order to gauge public opinion, EPA used public comment forms

196. Peltzman, supra note 182, at 213.
197. See infra notes 211-13 and accompanying text.
200. See generally M. Freeman, supra note 165, at 86-105.
and solicited responses at the three day hearing. The public comment forms contained the following questions:

1. What additional information would be helpful to the public?
2. How can we improve the workshop agenda, speeches, discussion, etc.?
3. Are there any other comments you would like to make about the review process or about the proposed arsenic emission standards?

The public comment forms drew diverse responses, although the majority of the responses appeared to favor closure. One of the stronger advocates for closing the smelter wrote, "Dispite [sic] all the stochastic crap someone should shut down the source of the poison." Another advocate of closure wrote, "Please quit hedging and recognize that ASARCO, even with BAT, is a public health hazard well outside the ample margin of public safety."

Responses such as these indicate that the methods EPA used to gauge public opinion of the benefits of an emission reduction suffer from significant flaws. Since the substantive question on the comment form and the testimony at the hearing were undirected, many responses were hard to categorize and analyze. In addition, those who opted to submit public comment forms may not accurately represent the opinions of the public at large. Moreover, only 140 individuals testified at the hearings. Thus opinions of people in this small self-selected sample may not be representative of the opinions of the entire interested population.

Even if the public is polled using more accurate methods, there are still problems with EPA's approach to the five-step process. Significantly, the public does not necessarily base its decisions on the expert information developed in the first four steps. The Baird surveys suggest that this is what occurred in the ASARCO case.

The Baird surveys addressed three issues: (1) how well informed the area residents were; (2) what residents believed should be done about the smelter; and (3) why residents believed what they did about the smelter. The surveys revealed that neither those attending the hearings nor those contacted in the phone poll fully understood the risks involved, although individuals at the meeting appear to have had a better understanding. Almost all individuals in the poll vastly overstated EPA's estimate.

204. Author's impressions of hearings held November 2, 1983 through November 4, 1983. See also supra note 201 and accompanying text.
205. See generally supra text accompanying notes 196-97.
206. Interview with L. Kral, supra note 62.
207. See supra notes 67-72 and accompanying text.
of the number of people in the immediate area who would contract cancer as a result of ASARCO's emissions.\textsuperscript{208} The median response was that fifty individuals would contract lung cancer.\textsuperscript{209} In comparison, fifty-three percent of those at the hearing gave answers in the correct range of one to five lung cancers.\textsuperscript{210}

A majority of individuals contacted at the hearing appeared to favor stronger controls than EPA proposed. When asked, "Would you favor stronger controls than the EPA proposed?" fifty-eight percent polled at the hearing responded "yes," thirty-four percent responded "no," and eight percent responded "don't know." Those favoring stronger controls fell to fifty percent when asked, "Would you favor stronger controls than the EPA has proposed even if it means the smelter would have to close and eliminate jobs?"\textsuperscript{211} Individuals contacted in the phone survey, on the other hand, did not appear to clearly favor or oppose stronger controls than those proposed by EPA. A majority of those having an opinion favored stronger controls in the abstract,\textsuperscript{212} but the results were reversed when the possibility of job loss was included.\textsuperscript{213} These responses indicate that the possibility of unemployment in the region has some impact on individual positions.

Baird's analysis suggests that individuals based their opinions on informal risk estimates rather than formal risk estimates conducted by EPA. These informal risk estimates depended on factors such as general attitudes towards environmental issues and the employment of family members at the smelter. Those with family members employed at the smelter tended to deny personal vulnerability to the cancer risk associated with arsenic emissions.\textsuperscript{214} Knowledge of EPA's formal risk estimates had only a weak effect on informal risk estimates.\textsuperscript{215} The results summarized above led Baird to conclude, "[A]lthough informed decisionmaking might be the ideal upon which one would hope policy decisions would be made, when such decisions are opened to public involvement factual information may play a relatively minor role in determining the public response."\textsuperscript{216}

\begin{thebibliography}{9}
\bibitem{208} Summary Data, \textit{supra} note 67, at question 23.
\bibitem{209} \textit{Id.}
\bibitem{210} Baird Preliminary Report, \textit{supra} note 67, at 8.
\bibitem{211} Summary Data, \textit{supra} note 67, at question 8.
\bibitem{212} \textit{Id.} at question 7.
\bibitem{213} \textit{Id} at question 8. Another survey was conducted by the union representing most of the ASARCO workers. That survey found that roughly 90% of the residents of the Tacoma area did not believe the smelter posed a significant health hazard. Seattle Times, Nov. 3, 1983, at C-1, col. 1.
\bibitem{216} \textit{Id.}
\end{thebibliography}
It appears then, that even if EPA had employed more accurate techniques to gauge public opinion, the public in the ASARCO case probably would not have based its decision on emissions reduction primarily on the information that EPA supplied.\footnote{Id. at 26.} Thus, limiting public opinion to the fifth step of the five-step process of evaluating the benefits of an emissions reduction suffers, to a large degree, from the same flaw as the complete public decisionmaking approach.

5. Conclusion—The Case for Modified Expert Decisionmaking

Although it has serious flaws, expert decisionmaking based on the public valuation of costs and benefits produces more rational results than public decisionmaking. Expert decisionmaking involves consideration of more information in, and greater understanding of, the first four steps necessary for proper risk assessment.\footnote{See supra notes 166-77 and accompanying text.} As the Baird survey shows, this is true even when the government tries to educate the public.\footnote{Baird Preliminary Report, supra note 67, at 26.} Further, when expert understanding of the value of benefits and costs is based on different individuals' valuations of a variety of selected costs and benefits, the expert can more readily select the optimal level of control than the public can because of the difficulty of designing a public decisionmaking mechanism.\footnote{See supra notes 188-200 and accompanying text.}

The following proposal attempts to set out an expert decisionmaking plan that will lead to the selection of the optimal policy. The expert regulator should ask the public hypothetical questions that explicitly set out the tradeoffs between different levels of control. The respondent's answers would be completely based on information in the questions. This would allow the expert regulator to isolate the public's view of the value of costs and benefits from the public's view of whether a particular cost or benefit might result from a particular emissions reduction. In addition, the expert regulator should attempt to target the surveys at the probable beneficiaries and victims of emissions reduction, including those who are geographically distant.

EPA probably intended to follow a model like the one proposed here in the ASARCO case.\footnote{See supra note 143 and accompanying text.} However, the Agency's failure to develop a systematic means of registering public opinion created problems. Instead of using a questionnaire like the one described above, EPA relied on uncontrolled responses from comment forms and hearings to determine the public's valuation of the tradeoffs of each alternative. Asking people whether they would reduce emissions, however, does not reveal the value they place on the effects of those reductions. More specific
information gathering mechanisms would have given EPA a better understanding of those values. Furthermore, EPA conducted no surveys targeting probable beneficiaries and victims of emission reduction.

There are two criticisms to the proposed decisionmaking approach, however. First, the polling procedures suggested here may not provide accurate information. Individuals might engage in strategic behavior and choose a hypothetical answer that overstates the true value they place on a loss or gain associated with a policy.\(^\text{222}\) Individuals might also take hypothetical questions lightly and not attempt to answer them truthfully.\(^\text{223}\) This criticism merely emphasizes the need to interpret this data carefully and recognize its limitations. Second, allowing EPA to rely on such information might increase its discretion under the guise of implementing public values. For example, the Ruckelshaus proposal, allowing the public to decide whether to close ASARCO, might be viewed as a way for EPA to justify its own desire not to impose strict regulations or for EPA to spread the blame for closing the plant.\(^\text{224}\) However, judicial review of EPA actions in light of statutory language and the factual record limits EPA's ability to abuse the information discussed here.\(^\text{225}\)

V

STRATEGIC BEHAVIOR

A. The Problem of Strategic Behavior

1. The Theory of Strategic Behavior

Strategic behavior occurs in any multiparty transaction when one party uses information unknown to the other to his own advantage. Perhaps the clearest example of strategic behavior is the misrepresentation of the value of a good or service.\(^\text{226}\) The party who misrepresents the value benefits if the other party accepts the misrepresented value as the true value.

Regulation provides ample opportunities and incentives for strategic

\(^{222}\) M. Freeman, supra note 165, at 87-96.

\(^{223}\) Id. at 97-99.

\(^{224}\) These possibilities were suggested by a number of people including environmentalists. Chasan, supra note 30, at 40.


\(^{226}\) Car purchase negotiations provide a classic example. The purchaser knows what price he will pay. The seller knows what price she will accept. However, each has an incentive to misrepresent these values. The purchaser will indicate that his maximum price is lower than it actually is. He does so because if the seller knew the purchaser's maximum price, the seller would not accept an offer below that price. The buyer, therefore, by misrepresenting the maximum price he will pay, preserves a chance to buy the car at a level below his maximum price.
The regulator generally knows less about a regulated firm's operations than the firm does. The regulated firm may try to use this advantage to deceive the regulator, encouraging her to select a policy more favorable to the regulated firm. The adoption of such a policy reduces the burden of regulation on the firm and increases its profits. Unfortunately, the policy selected on the basis of this faulty information usually fails to maximize social welfare, and thus the public loses if the regulator is unable to reduce or eliminate strategic behavior.

2. Evidence of Strategic Behavior in Pollution Regulation

There are two important facts that a regulated firm can misrepresent. The firm can deceive EPA about the cost schedule of reducing emissions and about the point at which the factory will have to shut down due to the costs of further emissions reduction. A shutdown will take place when the costs of control exceed the difference between profits from current use of the factory and the profits from the next best use of the factory. Thus, the firm can manipulate its perceived shutdown point by misrepresenting this profit differential.

a. Control Costs

To analyze whether a firm is actually misrepresenting compliance costs to gain favorable environmental regulation, the firm's pre-control cost estimates must be compared to its actual costs. If the former consistently overstate the latter, the firm may be using cost information strategically. No clear evidence exists that firms generally engage in this practice, although one study conducted for EPA found that pre-control estimates by firms do tend to be higher than their post-control esti-
mates.\textsuperscript{231} There are difficulties with this analysis, however. Actual compliance costs are difficult to determine, and estimates of pollution control costs are based on cost studies which do not consider that many of the firms in each source category\textsuperscript{232} probably have not complied with the regulations.\textsuperscript{233} Since cost studies are based on the average cost of all plants in a source category, the reported post-control estimates tend to understate the actual compliance costs.\textsuperscript{234} Moreover, post-control estimates do not differentiate between spending on pollution control to comply with EPA regulations and spending to comply with state regulations, or between spending to control pollution and spending to update equipment.\textsuperscript{235}

Misrepresentation of control costs can also be discerned by comparing the firm's pre-control estimates with EPA's pre-control estimates, and one EPA study suggests that industry estimates of pre-control costs tend to be higher than EPA estimates.\textsuperscript{236} However, EPA estimates of compliance costs may be unreliable because EPA lacks the information to make better estimates and because its estimates, to some extent, depend on information provided by the regulated firms. Thus, the firms can bias EPA estimates.

\textit{b. Shutdown Threats}

Firms facing environmental regulation frequently employ shutdown threats. For example, when Congress and EPA regulated automobile emissions they faced repeated threats by the the auto industry that Detroit would have to shut down unless the required standards were rolled back.\textsuperscript{237} Each time Detroit threatened to stop operations, Congress or EPA responded by rolling back the standards.\textsuperscript{238}

Companies operating lead, copper, and zinc smelters have often threatened to close if stringent emission standards were enforced.\textsuperscript{239} The smelters have used this threat to convince states to write favorable regulations as part of state implementation plans for achieving federal air

\begin{itemize}
\item \textsuperscript{231} Putnam, Hayes & Bartlett, Inc., \textit{Comparisons of Estimated and Actual Pollution Control Cost for Selected Industries}, reprinted in \textit{COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY—1980: THE ELEVENTH ANNUAL REPORT 399} (1980).
\item \textsuperscript{232} Source categories are groups of industries that have similar emission problems. Examples are electric utilities, pulp and paper manufacturers, iron and steel producers, and petroleum refiners. \textit{Id.} at 398.
\item \textsuperscript{233} \textit{Id.}
\item \textsuperscript{234} \textit{Id.}
\item \textsuperscript{235} \textit{Id.}
\item \textsuperscript{236} \textit{Id.}
\item \textsuperscript{237} Wall St. J., Oct. 4, 1976, at 4, col. 2.
\item \textsuperscript{239} R. MELNICK, supra note 108, at 223-27.
\end{itemize}
quality standards. EPA has challenged these state implementation plans in federal district courts, and in a number of cases federal district courts have sided with the smelters.\footnote{See, e.g., Anaconda Co. v. Ruckelshaus, 352 F. Supp. 697 (D. Colo. 1972); Kennecott Copper Corp. v. Train, 424 F. Supp. 1217 (D. Nev. 1976).} While courts of appeals have generally overturned the district court decisions,\footnote{See, e.g., Anaconda Co. v. Ruckelshaus, 482 F.2d 1301 (10th Cir. 1973)); Kennecott Copper Corp. v. Costle, 572 F.2d 1349 (9th. Cir. 1978).} the polluters have, at a minimum, delayed regulation.\footnote{R. MELNICK, supra note 108, at 224.}

3. 

Evidence of Strategic Behavior by ASARCO

ASARCO delayed regulation several times by threatening that regulation would force closure of the Tacoma smelter.\footnote{See supra notes 33-34 and accompanying text.} No evidence suggests that ASARCO overstated the costs of pollution control;\footnote{244. This lack of evidence may be explained in several ways. First, EPA might have accepted ASARCO's estimates without any further research. Second, since EPA had previously prescribed specific control technology for other smelters, EPA might have had good information on control costs and thus may not have been susceptible to deception.} however, the truth of ASARCO's claims in these cases cannot easily be determined since no reliable disinterested estimates of ASARCO's cost control schedule exist. The claim that ASARCO engaged in strategic behavior is especially uncertain in view of ASARCO's decision to cease smelting operations when it was faced with a significant emissions limitation.\footnote{See supra notes 75-77 and accompanying text.}

While it is uncertain whether ASARCO engaged in strategic behavior, it certainly had the incentive to do so. By overstating control costs and claiming that shutdown would occur at a lower level of emissions control than it actually would, ASARCO might have led regulators to promulgate less stringent regulations and saved itself considerable expense.\footnote{See infra notes 259-60 and accompanying text.}

B. Approaches to Regulating Arsenic Emissions

The opportunities for a regulated firm to engage in strategic behavior depend on the method EPA uses to regulate emissions. Thus it is important to examine the possible opportunities to engage in strategic behavior under each method of regulating arsenic emissions.

EPA could regulate arsenic emissions from the ASARCO smelter in four ways. EPA could: (1) set a quantity standard limiting the amount of arsenic the smelter can emit (the emissions standard approach); (2) specify the pollution control equipment ASARCO must install and work rules it must follow (the required technology approach); (3) create a
"pollution tax" that would force the firm to pay a penalty for each unit of pollution emitted (the pollution tax approach); or (4) set up an auction scheme to sell the right to pollute at prices determined by the marginal benefit curve (the Vickrey auction).

In general, EPA has regulated emissions by setting quantity standards. Section 112 requires an emissions standards approach when possible.247 In some cases, though, the emission standards approach may not be feasible because the difficulty of measuring emissions may make EPA unable to determine if a firm has complied with the standards. In such cases, section 112 allows EPA to require a polluter to install specific technology and to employ certain work rules.248 In these cases, EPA only needs to ensure that the proper equipment is installed and that the work rules are followed. In fact, in the ASARCO case, EPA proposed requiring specific control technology because of difficulties in measuring emissions.249

Several economists have recently advocated using a pollution tax approach to carrying out section 112.250 Under this approach, the regulator would tax the firm for each unit of pollution that it produced. In a world without shutdown problems and with continuous marginal benefit and marginal cost curves, the regulator should charge p* (see Graph 1, above), the rate that would induce the firm to remove q* units, the optimal pollution removal point.

The fourth proposal for regulating emissions is the Vickrey auction, illustrated in Graph 5.251 Under this approach the firm may buy the right to release a unit of pollution at a price equal to the marginal benefit of eliminating that unit of pollution.252 The firm will purchase air rights up to the point where the purchase price equals or exceeds its cleanup cost, which will occur at q*. The firm would pay the regulator an amount equal to the area under the marginal benefit curve from q* to zero emissions.253 In effect the firm pays for the benefits that would have resulted from removing the pollution that it does not control, rather than paying the costs of removing that pollution.

249. EPA Proposed Arsenic Standards, supra note 7, at 33,123.
252. This can be viewed as a tax which varies with the emission rate and follows the marginal benefit curve.
253. For a discussion of how the mechanism works with multiple firms, see Collinge & Bailey, supra note 251, at 225-31.
The regulator faces greater information demands under a Vickrey auction than she does under the other regulatory schemes. To find the optimal emission point under the other schemes, the regulator must have information about marginal costs and benefits only at levels of pollution near the optimum point. By contrast, the Vickrey auction requires the regulator to know all points along the marginal benefit curve. Given the difficulty of estimating the benefits of a pollution reduction and of monitoring emissions, a Vickrey auction may not be practical.

Because the achievement of maximum social welfare by each of these methods depends on accurate estimates of the costs and/or the benefits of control, each method is likely, in practice, to fall short of the optimal result. Strategic behavior by a polluter is one potential source of inaccuracy. The form that strategic behavior takes, however, depends on which of the four regulatory schemes the regulator employs.

254. Since the regulator is only concerned with the value of the benefits of pollution control, she does not need information about the marginal costs of reducing pollution.

255. See supra notes 164-79 and accompanying text.

C. Incentives to Misrepresent Control Costs Under The Various Schemes

1. The Emissions Standard Approach

Under an emissions standard approach, a firm has an incentive to overstate its cost schedule in the hope that less stringent and less expensive regulation will result. This hope is based on the assumption that EPA seeks to reduce emissions to the point at which marginal costs equal marginal benefits. If the firm overstates its compliance costs, EPA will require the firm to reduce emissions to the point where its reported marginal costs equal the actual marginal benefits, as is demonstrated in Graph 6. By overstating its actual cost, the firm can induce the regulator to set the standard at $q'$ rather that $q^*$. The firm saves the costs of reducing emissions from $q'$ to $q^*$. The amount saved by the firm equals the area ABCD.

GRAPH 6
Misrepresentation of Costs under an Emissions Standard Approach

The only way EPA could detect firm misrepresentation of pollution control costs is to monitor actual pollution abatement expenditures to determine whether they are equivalent to the represented costs, but there
are numerous problems in monitoring such expenditures. Most significantly, EPA must rely on the firm's reports of abatement expenditures. The firm can misrepresent its costs by reporting nonabatement capital and operating expenses as pollution control expenditures. Further, some costs, such as decreased performance, occur indirectly and are not easily estimated. A firm could overstate these costs to cover up its misrepresentations.

In addition, under an emissions standard approach, EPA must monitor emissions to determine whether a firm actually has reduced its emissions to the permitted level. However, EPA also faces difficulties in monitoring emissions.

2. The Required Technology Approach

A required control technology approach, the approach used to regulate arsenic emissions from the ASARCO smelter, does not avoid the strategic behavior problem. A firm can still misrepresent the cost of technology to induce EPA to adopt a technology that is cheaper and allows a greater than optimal level of emissions. To determine whether the firm misrepresented the cost of technology, EPA would have to monitor the firm's expenditures for the control technology. As discussed above, however, monitoring pollution control expenditures is problematic. The problem is alleviated somewhat by using the required technology approach since EPA will have studied the cost of the specified technology prior to selecting it. However, EPA's knowledge of off-the-shelf costs does not solve the problem, since the total cost of abatement includes the costs of installing, operating, and maintaining the technology. These costs vary from firm to firm.

A required technology approach would circumvent, to some extent, the problem of monitoring emissions. Since EPA should know the level of emissions associated with the control technology, it should not have to monitor emissions. EPA will have to monitor the firm's use of the control technology, however, since the level of emissions will vary depending on firm's maintenance and operational policies.

3. The Pollution Tax Approach

Regulation of emissions by taxing pollution gives the firm an incen-

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257. See supra notes 232-36 and accompanying text.
258. See EPA Proposed Arsenic Standards, supra note 7, at 33,135. EPA's revision of current emission estimates at the ASARCO smelter indicates the difficulties involved in monitoring emissions. See supra note 73 and accompanying text.
259. See supra note 232-36 and accompanying text.
260. One significant example of the effect of maintenance is auto emissions regulation. Emissions increase dramatically if the pollution control equipment is not maintained for the life of the car. See H. Jacoby & J. Steinbruner, Clearing the Air: Federal Policy on Automotive Emissions Control 91 (1973).
tive to underrepresent its control costs. Since a firm's tax rate varies directly with the control costs it reports, the firm minimizes its tax rate by reporting low control costs. It is as if the regulator were to ask the firm the price it would pay for air rights. The firm will obviously understate the price with the hope of purchasing the air rights more cheaply.

The firm's advantage in understating its control costs is demonstrated in Graph 7. If the firm reports its true control costs to the regulator, the regulator selects tax rate \( p^* \). The firm incurs control costs and taxes equal to area ECDHF. If the firm reports lower control costs, the regulator will select tax rate \( p^1 \). The firm will incur control costs and taxes equal to EABHF. The firm saves an amount equal to the area ACDB by reporting costs below its actual costs.

**GRAPH 7**

**Misrepresentation of Costs under a Tax Approach**

If EPA uses the pollution tax approach, it can monitor the accuracy of a firm's reported costs by monitoring emissions from the plant. Given the firm's reported costs and the tax rate corresponding to those reported costs, \( p^1 \), the firm should remove \( q^2 \) emissions, as shown in Graph 7. In determining its actual level of emissions reduction, the firm will look at its real cost curve. With tax rate \( p^1 \), the firm maximizes its profits by removing \( q^1 \) units. If EPA can accurately monitor emissions and discover the gap between \( q^1 \) and \( q^2 \), then it can detect cost misrepresenta-
tions. In some cases, however, including the ASARCO case, it may be difficult to monitor emissions.\textsuperscript{261}

4. The Vickrey Auction

A Vickrey auction approach will elicit honest responses from the firm if EPA can monitor emissions.\textsuperscript{262} This is demonstrated in Graph 6 (above). If the firm overstated its cost of control and purchased enough pollution permits to require it to remove $q$ units of pollution, it would be penalizing itself. The penalty the firm suffers for adopting such a strategy equals the area $ABE$. The penalty occurs because the firm is purchasing pollution permits when it would be cheaper for the firm to remove $q$ units of pollution. Similarly, if the firm understated its costs, it would incur a penalty because it would be cheaper to pay for the right to pollute up to $q^*$ than to reduce pollution. The firm therefore has an incentive to represent its costs honestly.\textsuperscript{263} If EPA cannot monitor emissions, however, there is no way to ensure that the firm is not emitting more pollution than it has a right to emit, and the Vickrey auction breaks down.

D. Incentives to Misrepresent the Shutdown Point

Under Various Schemes

In addition to misrepresenting control costs, a firm may attempt to manipulate the level of regulation by misrepresenting its shutdown point. Under all four regulatory schemes, a firm has an incentive to indicate that the plant will shut down at a lesser degree of control than it actually will, as long as a shutdown results in a discontinuous increase in costs and the regulator seeks to maximize the social welfare. There are, however, circumstances in which a firm has no incentive to misrepresent its shutdown point.

The incentive to use shutdown threats can be illustrated by considering regulation under the emissions standard approach. Under this approach, EPA can reduce pollution to the point where any additional control costs would cause a shutdown, or it can eliminate pollution entirely by forcing the firm to shut down.\textsuperscript{264} If the firm misrepresents the shutdown point, the Agency may impose a lighter regulatory burden, i.e., permit a greater level of emissions, in order to avoid shutdown. If EPA selects the first alternative, the firm’s cost of compliance will be reduced.

Table 4 illustrates a case where the firm gains by misrepresenting its

\textsuperscript{261} See supra note 258.
\textsuperscript{262} Collinge & Bailey, supra note 251, at 222-26.
\textsuperscript{263} Id.
\textsuperscript{264} This presumes that the Agency has no power to tax or subsidize the firm. If the Agency had these powers, other alternatives would be available. The Agency could subsidize the firm’s pollution control expenditures and require control beyond the shutdown point.
shutdown point under the emissions standard approach. This example assumes that the benefits to the breather of a complete shutdown, $200.00, will be entirely offset by a $200.00 loss caused by shutdown related job losses. By understating its profits by $26.00, the firm indicates it will shut down if the regulator implements Policy 2. The regulator perceives that it is faced with a choice between Policy 1 and shutdown, since it believes Policy 2 will result in shutdown. Faced with the choice between Policy 1 and closing the firm, the regulator will select Policy 1, because he perceives that society will get net benefits of $50.00 under Policy 1 but no benefit if the firm closes. In reality, the firm will not shut down if Policy 2 is selected, as the firm still earns $1.00. The regulator would select Policy 2 if he knew the firm would not shut down, because the true net benefits are $126, greater than the perceived or real benefits under Policy 1. By misrepresenting its profits, the firm saves itself $75.00, the additional cost of Policy 2. The breather loses $125.00, the benefits of Policy 2, and society overall loses $50.00, the difference between the firm’s saving and the breather’s loss.

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A firm’s ability to use shutdown threats strategically, as illustrated in Table 4, is limited in two respects. First, a firm that the regulator should shut down anyway, because the net benefits of a shutdown exceed the net benefits of any lesser degree of control, has no incentive to lie about its shutdown point. Such a firm would be closed no matter where it represented its shutdown point to be. Second, even a firm which the regulator should not shut down has only a limited incentive to misrepresent its shutdown point. If the firm reduces the perceived net benefits of control to the point where they are less than the net benefits associated with a shutdown, then EPA will elect to shut down the firm, and the firm
will be worse off since it loses profits. Thus a firm will only have an incentive to push the shutdown point back to where the net benefits of a shutdown equal the net benefits of controlling emissions to the shutdown point. This limited incentive is illustrated in Table 5. The assumptions in Table 5 are the same as those in Table 4 except that the unemployment losses equal $99.00. The benefits of a shutdown thus exceed the costs by $101.00. If the firm indicates it will shut down if the regulator selects Policy 2 or 3, then the regulator seeking to maximize the social welfare will choose to shut down the firm, because the perceived total benefits of shutting down the firm equal $101.00, whereas the perceived total benefits of choosing Policy 1 equal $74.00. If the firm honestly represented its shutdown point, the regulator would select Policy 2, and the firm would make $1.00 in profits. Limited to these three policy choices, the firm will have no incentive to misrepresent its shutdown point because it makes greater profits, $1.00, by honestly reporting its shutdown point.

TABLE 5

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<th>Policy 1</th>
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E. Conclusions On The Use and Prevention of Strategic Behavior

None of the regulatory schemes discussed in this Comment provides a polluting firm with an incentive to accurately report its control costs and shutdown point in all cases. The pollution tax approach, the emission standard approach, and the required technology approach all allow the regulated firm to misrepresent the cost of control. A pollution tax approach does have one apparent advantage in that misrepresenta-

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265. In theory it is possible to design a complicated scheme involving subsidies which would lead to honest responses. See Baron & Myerson, supra note 228, at 928-29. Such a scheme is impractical due to its complexity and the fact that a subsidy would not pass in Congress. Simple subsidy schemes would not lead to honest responses. A firm would have an incentive to overstate costs to get a larger subsidy from EPA. A simple subsidy program creates other problems as well. W. Baumol & W. Oates, supra note 92, at 173-90.
tions can be uncovered by accurately monitoring emissions alone, whereas under an emissions standard approach, misrepresentations can be uncovered only by accurately monitoring both emissions and expenditures. However, given the difficulty EPA had in monitoring emissions in the ASARCO case, a pollution tax approach enjoys no great advantage over an emission standard approach in regulating arsenic emissions.

The pollution tax and the Vickrey auction would increase the costs a polluting firm faces. In addition to paying the cost of control to reach the selected emission level, the firm pays a fee for the units of pollution it emits. This added cost would increase the problem of shutdowns and the threat of shutdowns, because the additional cost would shift the actual shutdown point to a lower level of control. The Vickrey auction, in addition, has extremely burdensome information demands and seems politically impractical.

Thus EPA's present approach, or preferably, a more soundly based economic version of the Agency's present approach, presents the only practical alternative. EPA should improve its standard setting approach, however, by developing emissions and expenditure monitoring skills to enable it to detect deceptive estimates of control costs by firms.

CONCLUSION

This Comment suggests some answers to the three issues raised by EPA's regulation of arsenic emissions from the ASARCO smelter in Tacoma. First, it appears that a "conservative" cost-benefit approach provides the best basis for regulation of hazardous air pollutants. A health-only approach conflicts with the no threshold assumption made by EPA and suggested by scientific evidence. Also, regulating emissions on a health-only basis merely delays consideration of costs and benefits. EPA is better equipped than the courts or the public to perform the initial balancing of costs and benefits, particularly in light of the strategic behavior problems associated with emissions regulation. EPA can more readily monitor emissions and expenditures and determine when firms are engaging in strategic behavior than the courts can. A more complete cost-benefit approach along the lines suggested is likely to result in more rational regulations. Although an expanded cost-benefit approach raises several problems, they appear controllable with a carefully drafted stat-


267. One specific program EPA could implement would be a program of retrospective analysis. Such a program would enable EPA to check firm cost estimates after the fact and allow EPA to penalize firms that significantly misestimated control costs. Such a program was suggested ten years ago by the National Academy of Sciences. NAT'L ACADEMY OF SCIENCES, supra note 112, at 37.
ute. For example, EPA discretion could be controlled by a statutory list of factors that must be considered in setting standards under section 112.

Second, EPA should not defer shutdown decisions to the public. EPA possesses far better information upon which to base such decisions. Moreover, no public "voting" mechanism appears capable of measuring the intensity as well as the direction of the public's preference. Efforts aimed at obtaining the public's views, however, can provide EPA with valuable information upon which to base a decision. In order to obtain such information, EPA should engage in better designed, more formal surveys.

Finally, it appears that no simple changes in regulatory schemes will stop regulated firms from employing strategic behavior. In order to combat strategic behavior EPA should develop its emission monitoring and expenditure monitoring abilities. By doing so, EPA could more readily detect when firms are engaging in strategic behavior and, as a result, regulate the emissions of hazardous air pollutants more appropriately and consistently.