IMPACT OF TAXING COPPER, LEAD, ZINC OXIDE, FERTILIZER FEEDSTOCKS, COAL-DERIVED SUBSTANCES, AND RECYCLED METALS CERCLA SECTION 301(a)(1)(H/I) STUDIES

Final Report

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EXECUTIVE SUMMARY

Sections 301(a)(1)(H) and (I) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund") call for a report to Congress on the following:

- The Section 301(a)(1)(H) Study ("H Study") of "[A]n exemption from or an increase in the substances or the amount of taxes imposed by section 4661 of the Internal Revenue Code of 1954 for copper, lead, and zinc oxide, and for feedstocks when used in the manufacture and production of fertilizers, based upon the expenditure experience of the Response Trust Fund;" and

- The Section 301(a)(1)(I) Study ("I Study") of "[T]he economic impact of taxing coal-derived substances and recycled metals."

This report presents data and analyses for responding to CERCLA Sections 301(a)(1)(H/I).

Together, the H and I Studies require analyses of various issues surrounding potential CERCLA taxation of: (1) copper, lead, zinc oxide, and recycled metals; (2) fertilizer feedstocks and associated substances; and (3) coal-derived substances. These three areas form the three parts of this report. This Executive Summary presents the major findings of the report in each of these areas.

I. COPPER, LEAD, ZINC OXIDE, AND RECYCLED METALS

Copper, lead, and zinc oxide are exempt from the excise taxes imposed by CERCLA. It appears that there was also agreement within Congress at the time of CERCLA's passage that recycled metals should also be exempt from taxation. However, apparently because no administratively feasible method of exemption was suggested, CERCLA does not exempt recycled metals from the tax. Furthermore, because the three metals which are most extensively recycled -- copper, lead, and zinc -- are not currently taxed, the need for a recycling exemption was essentially moot when CERCLA was passed. The H and I Studies are to assist Congress in: (1) re-examining whether copper, lead, and zinc oxide should continue to be exempt from taxation; and (2) determining the economic impact of taxing these substances and of taxing recycled metals. To this end, this report provides background information and analyses with respect to two issues:

- Expenditure experience of the Response Trust Fund ("Fund") with respect to copper, lead, zinc oxide, and associated substances; and

- Economic impact of taxing copper, lead, zinc oxide, and recycled metals.

The work performed and major findings on each of these two issues are described below.

Expenditure Experience of the Fund with Respect to Copper, Lead, Zinc Oxide, and Associated Substances

Expenditure experience of the Fund with respect to copper, lead, zinc oxide, and associated substances can be defined broadly to include all National Priorities List (NPL) sites. The NPL is a reasonable proxy for the expenditure experience of the Fund because Fund monies have already been spent characterizing the NPL sites, some Fund resources have been spent carrying out or approving remedial or removal actions at NPL sites, and -- perhaps most important -- these sites represent the universe of remedial actions likely to be undertaken. Alternatively, the definition could be narrowed to include only expenditures pertaining to historical removal actions, historical remedial actions, and planned remedial actions. However, the available data from the approximately 210 approved immediate and planned removals in the period December 1980 to September 1983, the six remedial actions as of June 1984, and the 24 planned remedial actions for which records of decision are available may not be sufficient to assess the true extent of the problem.

When the broad definition of Fund expenditure experience (i.e., NPL sites) is employed, the evidence indicates that copper, lead, zinc,[1] and associated substances are found at a number of NPL sites, and that Fund expenditures will be attributable to releases of these substances. In particular, the analysis of NPL sites yielded the following conclusions:

- Copper, lead, and zinc are among the most frequently detected substances at NPL sites and adjoining environmental media. Copper and compounds are reported at 48 of the 538 updated NPL sites (nine percent), lead is reported at 162 NPL sites (30 percent), and zinc and compounds are reported at 74 NPL sites (14 percent). Lead is the second most frequently occurring hazardous substance at NPL sites.

- Based on a sample of 73 NPL sites where laboratory tests have been performed, copper, lead, and zinc each

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[1]It is not possible to determine from the HRS data base whether copper, lead, or zinc are present in metallic form at a site, or what specific compounds of each metal are present. Copper is listed in the data base as "copper and compounds," zinc as "zinc and compounds," and lead simply as "lead." Furthermore, there is no separate listing for "zinc oxide," one of the substances listed specifically in the H study.

exceed detectable limits in 85-95 percent of all water samples and in 96-99.7 percent of all soil samples. Associated substances were also present above detectable limits. Furthermore, a significant fraction of samples showed extremely high concentrations of copper, lead, and zinc because mean concentrations were many times higher than median concentrations for both soil and water samples.

When the narrower definition of Fund expenditure experience is employed, there is less evidence to indicate that Fund resources have been used to respond to releases of copper, lead, zinc oxide, and associated substances. Nonetheless, because these substances have been found at a number of sites where removal and remedial actions have been approved, it appears that even under this restrictive definition, expenditures are scheduled at sites where these substances exist. The analysis of historical removal actions, historical remedial actions, and planned remedial actions yielded the following findings:

- Copper, lead, and/or zinc are present at seven of the 26 NPL sites (27 percent) where there are EPA Records of Decision for remedial actions. One of these sites, Celtor Chemical Works, is an abandoned sulfide ore processing plant contaminated with copper, zinc, and cadmium.

- Of approximately 210 approved immediate and planned removals in the period December 1980 to September 1983, 17, or eight percent, involved copper, lead, and/or zinc. Lead was found in 13, or six percent, of the removals.

- For the six sites for which remedial actions have been completed as of June, 1984, copper, lead, or zinc were not reported at four of the sites; information is unavailable for the other two sites.

Economic Impact of Taxing Copper, Lead, Zinc Oxide, and Recycled Metals

A partial equilibrium economic model was developed for estimating the impact of taxing copper, lead, zinc oxide, and recycled metals under CERCLA. The model estimates the effects of alternative CERCLA tax rates on: (1) the quantity of U.S. primary production; (2) the quantity of U.S. recycled production, if applicable; (3) the quantity of U.S. imports; and (4) the market price. Two types of CERCLA taxes can be examined by the model: (1) a tax on U.S. primary production, U.S. recycled production (if applicable), and U.S. imports; and (2) exempting from taxation U.S. recycled production while taxing the other sources.

The recycled metals selected for analysis are copper, lead, and zinc. These metals were chosen on the basis of three criteria: (1) the taxable quantity of the metal must exceed 1,000 short tons to insure that the administrative costs of imposing the tax exceed the tax receipts; (2) the current CERCLA tax rate for elemental metals ($4.45/short ton) must be at least 0.25 percent of the current price of the metal, otherwise the impact of the tax on the recycling industry is likely to be negligible; and (3) the metal, a significant proportion of the compounds containing the metal, or wastes from the processing of the metal must be toxic.

The results of the model are highlighted below:

- A tax on copper comparable to the current CERCLA tax on other elemental metals ($4.91 per metric ton) would result in only a minimal long-run decrease in total copper consumption per year of one-tenth of one percent, about 2,000 metric tons annually (base case). The price of copper would increase 0.2 percent (base case), or $3.50 per metric ton, at the average 1982 producer price of $1,605 per metric ton.

- A tax on lead comparable to the current CERCLA tax on other elemental metals also would result in only a minimal long-run decrease in annual domestic lead consumption of one-tenth of one percent, or about 1,500 metric tons annually (base case). The price of lead would increase 0.6 percent (base case), or $3.14 per metric ton, at the average 1982 producer price of $563 per metric ton.

- A tax on zinc oxide of $3.93 per metric ton[2] also would result in only a minimal long-run decrease in total annual domestic zinc oxide consumption of one-half of one percent, or about 750 metric tons annually (base case). The price of zinc oxide would increase 0.4 percent (base case), or $3.84 per metric ton, at the average 1982 producer price of $981 per metric ton.

- A tax comparable to current CERCLA tax rates would have little significance for recycled copper, lead, or zinc supply, whether an exemption is granted or not.

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[2]This tax rate is based on existing CERCLA tax rates of $4.91 per metric ton on elemental metals multiplied by the amount of zinc (on a molecular weight basis) required to produce zinc oxide (80 percent).

- A tax of two percent of price would yield the following results under the base case assumptions:

  -- Copper consumption would decline by an estimated 0.6 percent while its price would rise 1.4 percent;

  -- Lead consumption would decline by an estimated 0.6 percent while its price would rise 1.5 percent; and

  -- Zinc oxide consumption would decline by an estimated 2.8 percent (most of which would be foreign supplied) while its price would rise 2.0 percent.

  If supply and/or demand are more price-sensitive than assumed in the base case, price effects would be less and quantity effects would be greater, suggesting that more of the tax would be absorbed by these industries.

- A tax of three percent of price would yield the following results under the base case assumptions:

  -- Copper consumption would decline by an estimated 0.9 percent while its price would rise 2.1 percent;

  -- Lead consumption would decline by an estimated 0.8 percent while its price would rise 2.2 percent; and

  -- Zinc oxide consumption would decline by an estimated 4.2 percent (most of which would be foreign supplied) while its price would rise 2.9 percent.

II. FERTILIZER FEEDSTOCKS

The H Study requires an analysis of the exemption from the taxes imposed by CERCLA for feedstocks when used in the manufacture and production of fertilizer, based upon the expenditure experience of the Fund. CERCLA exempts the following feedstocks from taxation when used in the production of fertilizers: ammonia, methane used to make ammonia, sulfuric acid, and nitric acid. As with metals, the analysis was conducted in two parts:

- Expenditure experience of the Fund with respect to fertilizer feedstocks and their derivatives; and

- Economic impact of taxing fertilizer feedstocks.

Expenditure Experience of the Fund with Respect to Fertilizer Feedstocks and Their Derivatives

Fertilizer-related releases are likely to be spills which occur in the normal course of distribution, so removal experience may be more relevant than remedial action experience in assessing the expenditure experience of the Fund. Expenditure experience of the Fund with respect to fertilizer-related materials can be defined narrowly as expenditures pertaining to historical removal actions, historical remedial actions, and planned remedial actions. Alternatively, the definition could be broadened to include potential removal and remedial actions (i.e., potential releases).

When the narrower definition is employed, there is little hard and fast evidence that Fund resources are used to respond to fertilizer-related releases. Of approximately 210 approved immediate and planned removals described in the Removal Tracking System for the period from December 1980 through September 1983, only seven might be fertilizer-related, based on the list of materials involved. Closer inspection of these seven removal actions suggests that only one is likely to be fertilizer-related. Furthermore, the On-Scene Coordinator's report for this removal says that most of the fertilizer on site was removed by a farming supply company, at no expense to the Fund. Fund resources were used to remove pesticides and some small amounts of suspected fertilizer materials however (Gebhart Fertilizer Co., Latham, Illinois, June 16, 1983). Analysis of historical and planned remedial actions could uncover no information which clearly suggests fertilizer-related Fund expenditure experience.

When the broader definition of expenditure experience is employed, it is possible to find evidence of fertilizer-related releases, but it appears that responsible parties generally respond to them. For example, of 101 releases since January 1981 in Region VIII which could be fertilizer-related, responsible parties completed action on 80, while the Federal government completed action on zero. The other 21 releases were either not responded to, responded to by local government, or it was not known whether there was a response.

In summary, regardless of the definition used, the evidence that Fund resources are used or likely to be used to respond to fertilizer-related releases is slight, particularly when contrasted with the evidence on metals.

Economic Impact of Taxing Fertilizer Feedstocks

The impact of taxing fertilizer feedstocks at levels currently specified in CERCLA is unlikely to significantly affect farmers. Although demand for fertilizers is relatively insensitive to price changes, so the tax would likely be passed on to farmers, the tax at current levels constitutes less than one percent of ammonia prices, and less than 0.5 percent of sulfuric acid and nitric acid prices. Because fertilizers constitute approximately seven percent of farm input costs, even if the tax were fully passed on to farmers, it would constitute no more than 0.07 percent total cost increase to farmers. This would be a minor factor when contrasted with the volatility of other factors affecting agriculture, such as interest rates, foreign trade policy, and the weather. Furthermore, because the demand and supply of fertilizers are both relatively insensitive to price changes and the CERCLA tax at current rates constitutes only a small percentage of the price, the effect on fertilizer markets will also be small. Finally, the increasing availability of fertilizer materials from low-cost feedstock countries and the rebound in demand in 1984 due to the end of the Payment-In-Kind Program and the general economic recovery, are likely to render any potential CERCLA tax effects insignificant in the near term future.

III. COAL-DERIVED SUBSTANCES

The I Study requires an analysis of the economic impacts of taxing coal-derived substances. At present, a tax on coal-derived feedstocks would affect two industries -- the metallurgical coke industry and the synthetic fuels industry. Feedstocks produced from coke oven by-products include benzene, toluene, xylene, naphthalene, and ammonia. For the coal-based synthetic fuel projects which may come on-line in the near future, only limited amounts of ammonia production would be subject to the tax.

Assuming the list of feedstocks and tax rates currently in Title II of CERCLA, a tax on coal-derived substances would generate approximately $2 million to $4 million annually, of which over ninety percent would be from coke oven by-products. The elimination of the exemption would probably have at most minor effects on the quantity of coal-derived substances produced for the following reasons:

- Generally, a tax will not affect the amount of crude by-products recovered in the coke-making process. The objective in the coke industry is the production of high-quality coke. Crude by-products are recovered as an ancillary benefit of coke-making, but the basic process is not altered to change the type and quantity of by-products produced.

- Some of the chemicals produced from coke oven by-products -- such as the aromatic hydrocarbons benzene, toluene, xylene, and naphthalene -- must be refined from the crude substances recovered directly from the coke ovens. In recent years, the cost of refining these products has increased as the amount produced has declined with decreases in coke production. As a result, many operators have ceased their advanced refining processes, choosing instead to use the by-products internally (e.g., as fuel), or sell them in their crude stage to other refiners. Elimination of the CERCLA tax exemption could theoretically accelerate this trend and lead to a small reduction in the amount of the coke oven by-products refined into CERCLA-taxed feedstocks. However, the markets for these feedstocks would be affected only marginally, as they are dominated by petroleum-derived substances.

- The price that producers receive for their coal-derived substances is often determined by petroleum-derived substances. In most instances, the petrochemical industry produces substantially more of a particular product (or a close substitute). Producers of coal-derived substances typically accept the price set by other producers (i.e., the petrochemical industry), making it very difficult to pass on the cost of a feedstock tax in the form of higher prices. As a result, the tax would be an additional operating cost to the coke producers, a cost that would generally have to be absorbed by the U.S. steel industry.

- Not all of the steel produced in the U.S. requires coke. About 30 percent of U.S. steel production is from electric arc furnaces, which use virtually no coke to produce steel. As a result, steel produced from electric arc furnaces does not generate coal-derived chemicals. The proportion of total steel production from electric arc furnaces has been increasing in recent years and is likely to continue to do so since this process competes very effectively in several market segments with the more traditional, less efficient basic oxygen process (which does generate coal-derived substances). The potential tax revenues which would result from an elimination of the exemption are not likely to be large enough to affect significantly the comparative economics of steel production.

For the coal-based synthetic fuel projects which may come on-line in the future, only limited amounts of ammonia production would be subject to the tax. Tax revenues resulting from up to three projects which (under optimistic assumptions) may possibly come on-line and produce taxable substances would be less than $400,000 annually. These costs would have to be absorbed by the synthetic fuel projects as the price of ammonia is determined by other economic factors. Because these synthetic fuel projects would in all likelihood be subsidized, the level of the subsidy would need to be increased, or a lower return would have to be accepted on the project. If the level of subsidy were increased, the tax would not raise any additional federal revenues, as the tax would be paid through additional federal subsidies for synthetic fuels projects (i.e., a transfer between federal accounts would occur).

1. INTRODUCTION

Section 301(a)(1) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund") requires the President to submit several studies to Congress by December 11, 1984. The President has delegated the responsibility to conduct the studies to the U.S. Environmental Protection Agency (EPA), in consultation with the Secretary of the Treasury.[1] This report provides information and analyses with respect to two of those studies:

- The Section 301(a)(1)(H) Study ("H Study") of "[A]n exemption from or an increase in the substances or the amount of taxes imposed by section 4661 of the Internal Revenue Code of 1954 for copper, lead, and zinc oxide, and for feedstocks when used in the manufacture and production of fertilizers, based upon the expenditure experience of the Response Trust Fund;" and

- The Section 301(a)(1)(I) Study ("I Study") of the economic impact of taxing coal-derived substances and recycled metals under CERCLA.

This introduction is organized in four parts: (1) the purpose of the H Study; (2) the purpose of the I Study; (3) the scope of this report; and (4) the organization of this report.

1.1 PURPOSE OF SECTION 301(a)(1)(H) STUDY

CERCLA established the Hazardous Substance Response Trust Fund (the Fund) to pay for the cleanup of hazardous substance sites and to restore natural resources damaged by releases of hazardous substances. The Fund is financed largely by a tax on petroleum and certain chemical feedstocks. During the Congressional debate on CERCLA, the issue of taxing copper, lead, zinc oxide, and fertilizer feedstocks to finance the Fund was controversial. The debate included both economic and toxicological arguments.

Opponents of taxing copper, lead, and zinc oxide characterized the metal industries as declining industries with low profit margins. They argued that the primary producers of these metals may not be able to pass through a CERCLA feedstock tax to consumers because the prices for the metals are competitively established in international markets. Primary processors of zinc and lead argued that the tax would accelerate the decline in domestic production, which could be adverse to the nation's strategic interests. In addition, the copper and zinc oxide producers argued that neither substance was a significant toxicant.[2]

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[1]Executive Order 12316, Section 8(c)(1), August 14, 1980.

[2]See, for example, pages S14975-S14977 of the Congressional Record for November 24, 1980.

The proponents of taxing copper, lead, and zinc oxide, on the other hand, argued that:[3]

- The metals were already designated as hazardous substances in their elemental form or were the primary building blocks of designated hazardous compounds and their processing generated hazardous wastes;

- The metals were implicated in many releases which damaged natural resources; and

- It might be impossible to pass through a CERCLA feedstock tax in bad years, but over several years of an economic cycle, no problem was evident.

In the debate over the CERCLA feedstock tax, the opponents of taxing fertilizer feedstocks argued that such feedstocks seldom appear in hazardous waste sites and that the impact of the tax could be detrimental to many farmers. Analyses submitted by EPA to Congress in 1980 largely refuted the economic and environmental impact claims of the opponents.[4]

CERCLA as enacted does not tax copper, lead, or zinc oxide to finance the Hazardous Substance Response Trust Fund. In addition, nitric acid, sulfuric acid, ammonia, and methane used to make ammonia are expressly exempt from the CERCLA tax when used as feedstocks in the production of fertilizer.[5] However, CERCLA Section 301(a)(1)(H) does require a study of:

> "[A]n exemption from or an increase in the substances or the amount of taxes imposed by [CERCLA] . . . for copper, lead, and zinc oxide, and for feedstocks when used in the manufacture and production of fertilizers, based upon the expenditure experience of the Response Trust Fund."

The purpose of the H Study is to assist Congress in re-examining whether copper, lead, zinc oxide, and fertilizer feedstocks should continue to be exempt from the excise taxes imposed by CERCLA. The study should address issues related to: (1) the extent to which these inorganics and associated substances contribute to hazardous substance release problems and the

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[3]Many of these arguments are presented in February 21, 1980 analysis by EPA entitled "Superfund Fee System As It Affects the Metal Smelting and Refining Industry."

[4]See EPA, "Superfund Fee System As It Affects Those Raw Materials Used by the Fertilizer Industry," undated; and Development Planning and Research Associates, Inc., "The Economic Impact of the Superfund Fee System on the Farm Sector - Fertilizer Usage," June 1980 (prepared for EPA).

[5]CERCLA Section 211.

expenditure experience of the Fund in response to such releases; and (2) the economic impact of taxing such substances.

Other possible criteria for examining whether copper, lead, and zinc oxide should continue to be exempt from CERCLA taxes, such as the health hazards associated with these substances, are not specifically addressed in this report. The H Study does not require such an examination. For a general discussion of other evaluative criteria, including the criteria used by Congress in selecting taxable substances in 1980, see "The Feasibility and Desirability of Alternative Tax Systems for Superfund, CERCLA Section 301(a)(1)(G) Study," December 1984.

1.2 PURPOSE OF SECTION 301(a)(1)(I) STUDY

Two additional issues that arose during the Congressional debate on CERCLA were whether (1) coal-derived substances and (2) recycled metals should be taxed to help finance the Hazardous Substance Response Trust Fund. The legislative record of CERCLA contains little discussion or analysis of either issue.

With respect to coal-derived substances, the opponents of taxing such substances argued that an exemption was desirable to provide additional incentives for the production of chemicals from coal. Proponents of taxing coal-derived substances argued that the substances produced from coal are no less hazardous than the same chemicals produced from oil and natural gas and that coal processes involve the threat of releases. The opponents were victorious; CERCLA, as enacted, does not tax coal-derived substances.[6]

With respect to recycled metals, it appears that there was widespread agreement within Congress that recycled metals should not be subject to the CERCLA feedstock tax. However, apparently no administratively feasible method of exemption was suggested and therefore CERCLA does not exempt recycled metals from the feedstock tax. However, as discussed in Section 3.3 of this report, the metals that are most extensively recycled (copper, lead, and zinc), are currently not subject to the CERCLA feedstock tax. Therefore, most recycled metal is not taxed under CERCLA.

As part of the compromise bill enacted by Congress, CERCLA Section 301(a)(1)(I) requires the President to submit to Congress a study of "the economic impact of taxing coal-derived substances and recycled metals." The I Study does not require analysis of the environmental consequences of coal-derived substances and recycled metals and associated processes and substances; it requires only an analysis of the economic impact of taxing coal-derived substances and recycled metals.

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[6]CERCLA Section 211.

1.3 SCOPE OF THIS REPORT

This report provides information and analyses for both the H Study and the I Study. A single report addresses both studies because two separate reports would overlap significantly. In particular, the copper, lead, and zinc industries would be a major focus of both studies. The H Study specifically requires copper, lead, and zinc oxide to be addressed; and, as part of the I Study analyses, the recycled metals selected for analysis of the impact of a CERCLA tax are copper, lead, and zinc.[7]

This report provides information and analyses of the issues related to the H and I Study requirements. An examination of releases of copper, lead, zinc oxide, fertilizer feedstocks, and associated substances has been performed. The relative occurrence of such substances at sites on the National Priorities List (NPL) and their presence in soil and waster samples taken at NPL sites has been documented. A methodology for analyzing the economic impact of taxing copper, lead, and zinc oxide under CERCLA (and for taxing, or exempting, recycled metals as part of the I study), has been developed. The effects on output and prices of a CERCLA tax are presented for copper, lead, and zinc oxide (and for recycled copper, lead, and zinc as part of the I study).

The expenditure experience of the Fund with respect to copper, lead, zinc oxide, fertilizer feedstocks, and associates substances is addressed only partially in this report. At present, it is not feasible to assign the costs of Superfund response actions to individual chemicals or groups of chemicals found at a site or in a spill. In order to be equitable in theory, as well as practical to administer, such a cost allocation would require rather exact information about the mix and quantities of chemicals present. It would also require an understanding of the response methods required or recommended for different classes of substances, to the extent that these methods and their costs may differ.

The scope of analysis required for the I Study is less extensive than for the H Study. CERCLA Section 301(a)(1)(I) requires analysis only of the economic impact of taxing coal-derived substances and recycled metals. The economic impact of taxing recycled metals is incorporated in the analyses of

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[7]As is described in more detail in Section 3.3, the recycled metals to be examined were selected on the basis of three criteria: (1) the taxable quantity of the metal must exceed 1,000 short tons to insure that the administrative costs of imposing the tax exceed the tax receipts; (2) the current CERCLA tax rate for elemental metals ($4.45/short ton) must be be at least 0.25 percent of the current price of the metal, otherwise the impact of the tax on the recycling industry is likely to be negligible; and (3) the metal, a significant proportion of the compounds containing the metal, or wastes from the processing of the metal must be toxic. Three metals satisfied these criteria: copper, lead, and zinc.

the effects of taxing primary metals (Chapters 4-6). Chapter 9 provides background information and preliminary analysis of the effects of taxing coal-derived substances. Because the I Study does not require an examination of the expenditure experience of the Fund with respect to coal-derived substances, this type of analysis is not included in this report. Such an analysis would be difficult because it is probably impossible to determine whether a particular substance found at a site was derived from coal-based feedstocks, oil-based feedstocks, or natural gas-based feedstocks.

1.4 ORGANIZATION

To summarize, this report is organized into nine chapters:

- Chapter 1 is this introduction;

Part I: Copper, Lead, Zinc Oxide, and Recycled Metals

- Chapter 2 addresses the expenditure experience of the Fund with respect to copper, lead, zinc oxide, and associated substances;
- Chapter 3 introduces the methodology for analyzing the economic impact of taxing metals for purposes of both the H and I Study analyses and selects the recycled metals for analysis as part of the I Study analysis;
- Chapter 4 presents the economic impact of taxing copper, with and without an exemption for recycled copper;
- Chapter 5 presents the economic impact of taxing lead, with and without an exemption for recycled lead;
- Chapter 6 presents the economic impact of taxing zinc oxide and of exempting recycled zinc from potential taxation of zinc;

Part II: Fertilizer Feedstocks

- Chapter 7 addresses the extent to which fertilizer feedstocks and associated substances have contributed to the problems of hazardous substance releases;
- Chapter 8 presents the economic impact of taxing fertilizer feedstocks; and

Part III: Coal-Derived Substances

- Chapter 9 addresses the economic effects of taxing coal-derived substances.

Three technical appendices are contained in "Impact of Taxing Copper, Lead, Zinc Oxide, Fertilizer Feedstocks, Coal-Derived Substances, and Recycled Metals, CERCLA Section 301(a)(1)(H/I) Study, Supplementary Report," December 1984:

- Appendix A identifies hazardous wastes associated with tax exempt substances;

- Appendix B identifies hazardous wastes associated with major uses of tax exempt substances; and

- Appendix C provides a technical description of the economic framework used for analyzing copper, lead, zinc oxide, and recycled metals.

PART I: COPPER, LEAD, ZINC OXIDE, AND RECYCLED METALS

2. CERCLA TAXES AND EXPENDITURE EXPERIENCE OF THE FUND WITH RESPECT TO COPPER, LEAD, ZINC OXIDE, AND ASSOCIATED SUBSTANCES

The requirements for the CERCLA section 301(a)(1)(H) and (I) studies are complex. Therefore, some preliminary discussion and analysis is necessary before presenting the methodology used to analyze CERCLA taxes and exemptions for the substances covered in these studies. This chapter provides both a backdrop for the following chapters and explores the issue of the Fund's experience with these substances. It is organized into three sections. Section 2.1 discusses the context of the H and I Studies. Section 2.2 explores the expenditure experience of the Fund with respect to copper, lead, zinc oxide, and associated substances. Section 2.3 provides a summary of the chapter.

2.1 CONTEXT OF SECTION 301(a)(1)(H) AND (I) STUDIES

2.1.1 The H Study

> [Experience with the implementation of this Act regarding] an exemption from or an increase in the substances or the amount of taxes imposed by section 4661 of the Internal Revenue Code of 1954 for copper, lead, and zinc oxide, and for feedstocks when used in the manufacture and production of fertilizers, based upon the expenditure experience of the Response Trust Fund.

The intent of the H study is complicated by the fact that certain derivatives of copper, lead, and zinc are currently taxed. Indeed, the language of the study could be interpreted as requesting a study of the impact of (1) continuing to exempt copper, lead, and zinc oxide, while maintaining current taxes on some of their derivatives, (2) taxing copper, lead, and zinc oxide at rates to be determined and removing the tax on the currently taxed derivatives, or (3) taxing only certain substances that are made using copper, lead, and zinc oxide at rates to be determined (these would not be identical to the substances currently taxed). For purposes of this report, the interpretation of the language of the H study was developed in the manner explained below.

First, copper, lead, and zinc oxide are not presently taxed. Thus, one interpretation of the study is that the impacts of taxing these currently exempt substances should be examined. The H Study description also implicitly asks what tax rates should be applied if these currently exempt substances were to be taxed by suggesting that the expenditure experience of the Fund be consulted to suggest what rates might be appropriate for these substances.

Second, although copper and lead are not presently taxed, some compounds and chemicals made from these substances are, such as cupric sulfate, cuprous oxide, cupric oxide, and lead oxide. Clearly, the intent of the H Study would not be to add a tax on copper or lead without eliminating the existing taxes on downstream compounds. If this were the case, then double-taxation of the intermediate products would occur -- an input (copper) to a substance that is itself taxed (cupric sulfate) would be taxed. Therefore, a reasonable interpretation of the H Study is that of replacing taxes on certain compounds of, e.g., copper, with a tax on the feedstock itself.

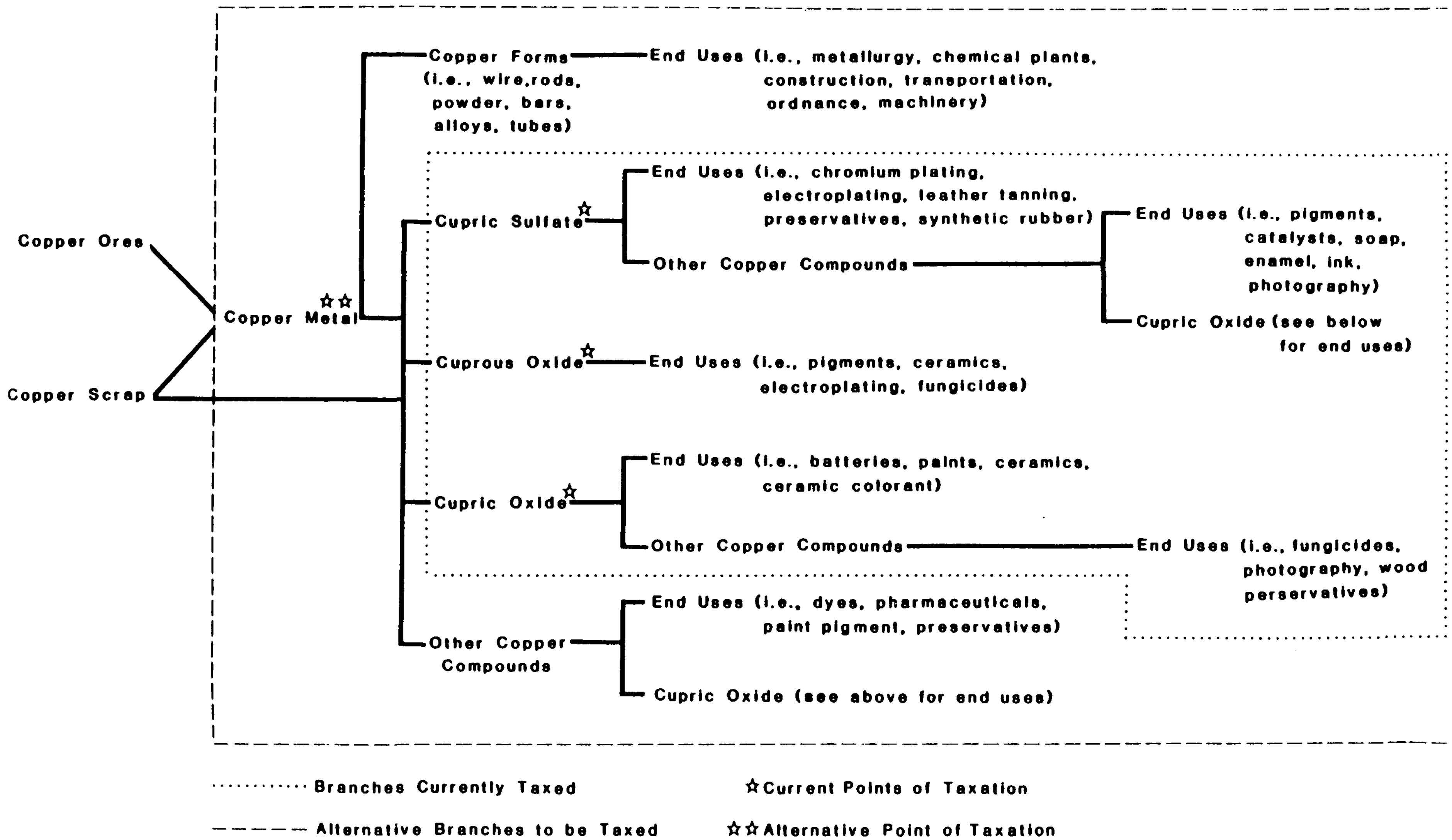
Two of the four substances mentioned in the H Study -- copper and lead -- have both taxed and untaxed compounds downstream. Exhibits 2-1 and 2-2 show the major derivatives of these two metals and indicate which branches of derivatives are currently taxed and which are not. Thus, the analysis of copper and lead in this report assumes that the taxes on the downstream derivative compounds would be removed and replaced with taxes on the metals themselves.

Third, zinc oxide requires a slightly different treatment. Exhibit 2-3 shows zinc and its major derivatives. Currently, two compounds derived from zinc are taxed -- zinc sulfate and zinc chloride. Zinc oxide, however, is exempt from the CERCLA tax. Therefore, to analyze the impact of removing the tax exemption for zinc oxide, there is no need to consider removing the taxes on the other zinc compounds since these are not "downstream" from zinc oxide. Thus, taxing zinc oxide simply adds a tax parallel with the existing taxes on zinc compounds.

The H Study also calls for analyzing taxes on copper, lead, zinc oxide, and fertilizer feedstocks in light of the expenditure experience of the Fund. The above interpretation of the H Study also has substantial implications for the meaning of "Fund experience." In the cases of copper and lead, the change contemplated is one of replacing taxes on downstream compounds with a tax on the primary feedstock. The context of the H Study suggests that an important determinant of whether taxes on copper and lead should replace taxes on compounds derived from them is the differential experience (if any) of the Fund with substances and their derivatives that are taxed and those that are not taxed.

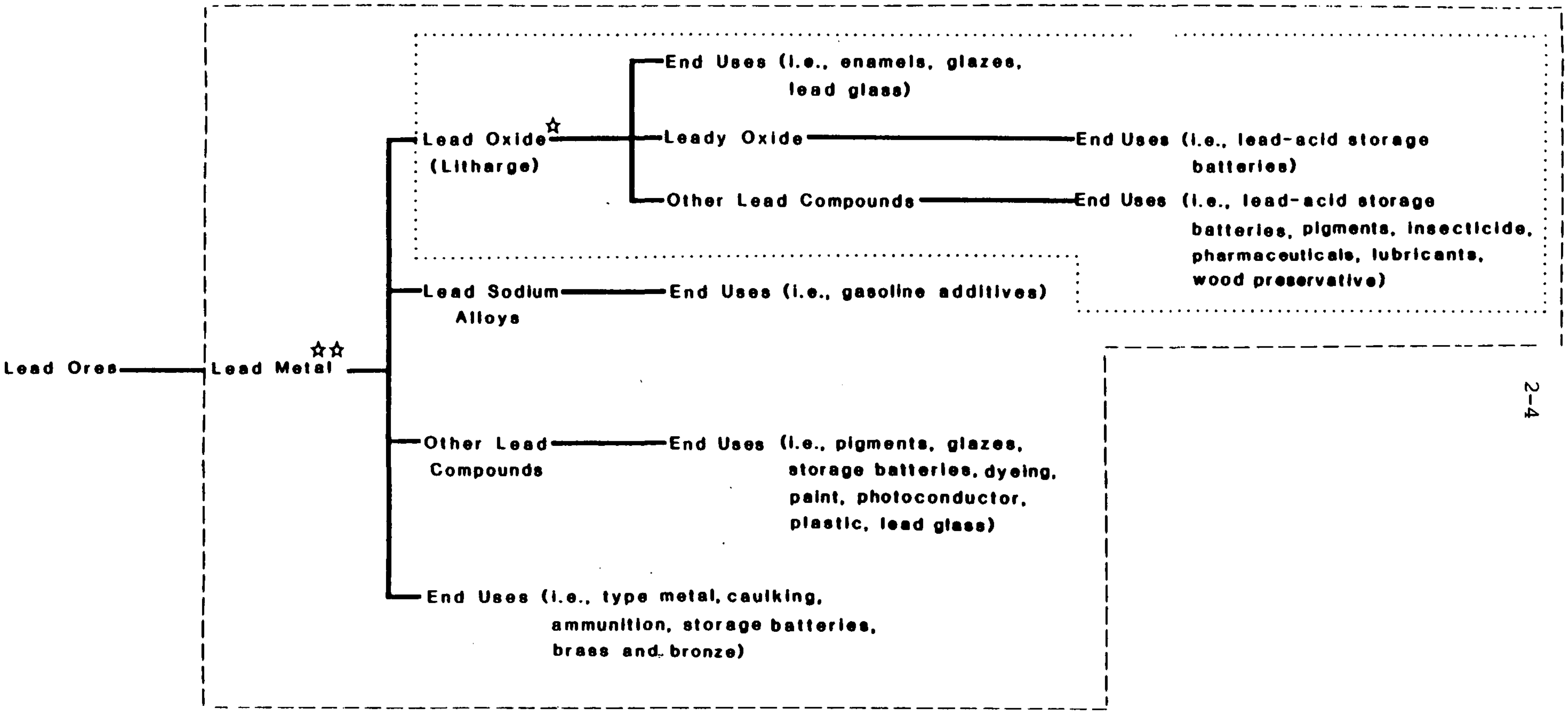
This issue is best understood by examining Exhibits 2-1 and 2-2. Suppose that Fund experience has involved expenditures caused by the presence of substances derived, in the case of copper, from both the taxed and the untaxed compounds of copper. That is, many of the substances along the untaxed branches of the copper products "tree" have been at least partially responsible for Fund expenditures. This establishes at least a *prima facie* case for replacing the taxes on compounds downstream with a single tax on the major feedstock to all of the branches that cause Fund expenditures -- for purposes of equity, incentives, and administrative feasibility. Of course, it may be that few, if any, of the substances produced through the untaxed branches of the copper and lead "trees" have been, or will be, responsible for Fund expenditures. In that case, Fund experience argues against replacing the downstream taxes with taxes on the metals themselves.

EXHIBIT 2-1
COPPER AND DERIVATIVES



Source: SRI, Chemical Origins and Markets 5th ed. (1977), pp. 38, 39.

EXHIBIT 2-2
LEAD AND DERIVATIVES

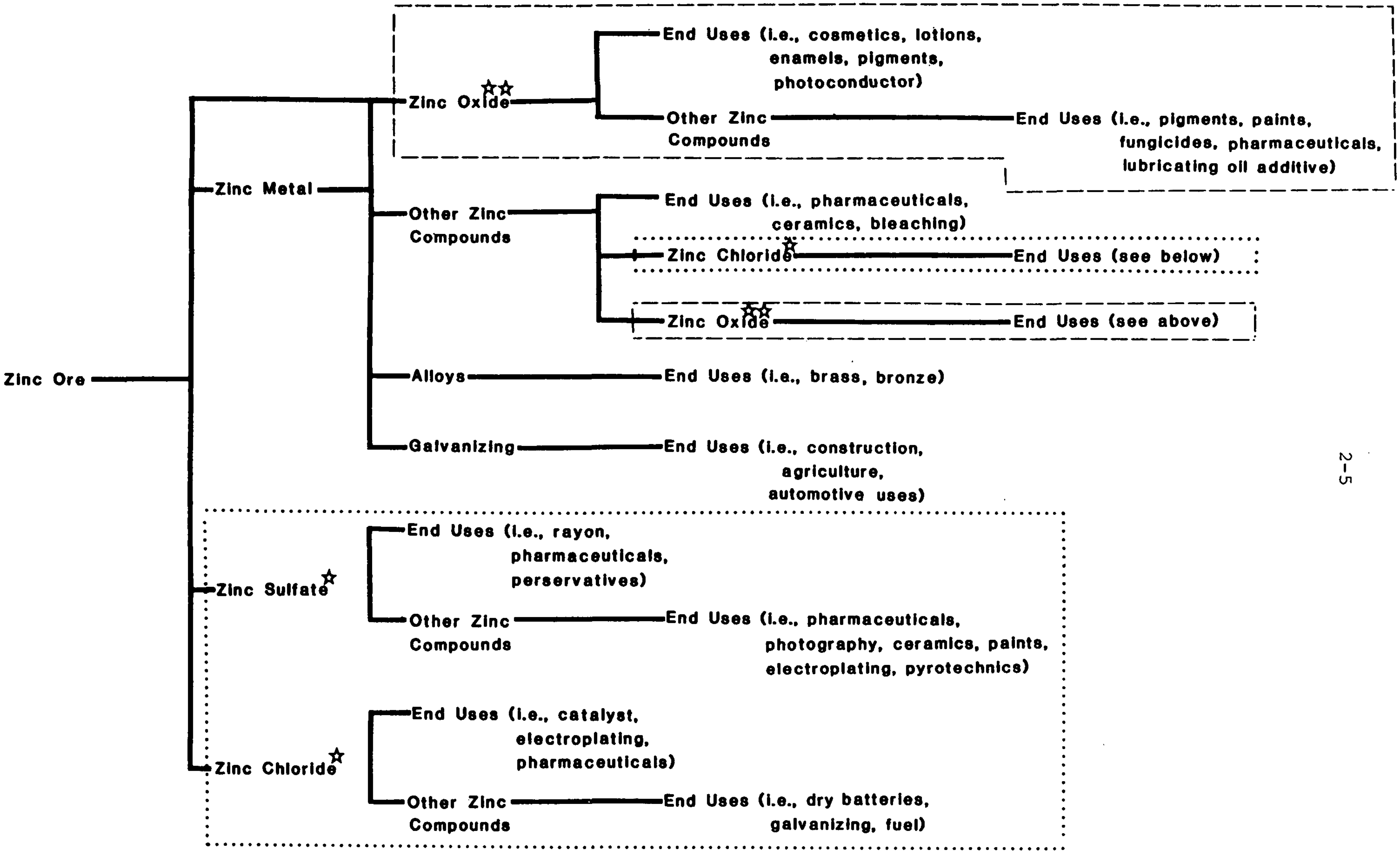


············ Branches Currently Taxed　　☆ Current Point of Taxation

– – – – – Alternative Branches to be Taxed　　☆☆ Alternative Point of Taxation

Source: SRI, Chemical Origins and Markets 5th ed. (1977), p. 48.

EXHIBIT 2-3
ZINC AND DERIVATIVES



.... Branches Currently Taxed

------ Additional Branches to be Taxed

☆ Current Points of Taxation

☆☆ Additional Points of Taxation

Source: SRI, Chemical Origins and Markets 5th ed. (1977), pp. 74-75.

The case of zinc oxide is similar, but not parallel. The Fund experience investigation in this case must determine whether substances derived from untaxed zinc oxide are responsible for Fund expenditures, along with substances derived from the taxed compounds of zinc. If so, then the case for including zinc oxide among the taxed compounds of zinc is bolstered. If not, then the opposite case is supported.

The point of this discussion is worth repeating. Evaluating the impact of taxing copper, lead, and zinc oxide based on the expenditure experience of the Fund is a more complicated exercise than determining whether copper, lead, and zinc oxide have been at least partially responsible for Fund expenditures. Instead, the relevant question in each of the three cases discussed here is whether Fund experience has been (or will be) the same or different for substances that are derived from taxed compounds versus those that are derived from those that are not currently taxed. The analysis in Section 2.2 of this chapter addresses this issue directly and in detail, and reports data from several sources to answer these questions as well as possible given available information.

2.1.2 The I Study

> [Experience with the implementation of this Act regarding] the economic impact of taxing coal-derived substances and recycled metals.

Coal derived substances are treated separately in Part III of this report, so the discussion here concerns only recycled metals. The I Study calls for an analysis of the economic impacts of taxing recycled sources of supply of metals. Clearly, such a study only really makes sense if the primary metal is taxed under CERCLA. Thus, supposing that a metal is subject to a CERCLA tax, the issue is to determine the difference between taxing recycled sources of supply and not taxing such recycled sources.

In the next chapter of this report, three criteria are presented that were used to determine which metals that have recycled sources would be examined under the analysis required for the I Study. Application of these criteria led to the selection of copper, lead, and zinc for analysis. A primary reason for their selection is that these are the only metals that have appreciable amounts of supply from secondary (recycled) sources. Thus, the potential impact of not exempting recycled sources of these metals might be significant, at least in terms of reduced quantities of these metals supplied from these sources.

The selection of copper, lead, and zinc as the metals to study for the I Study does, however, introduce some complication, because none of these metals are presently taxed. As the previous section pointed out, only derivatives of copper, lead, and zinc currently are subject to CERCLA taxes. Thus, to analyze the impact of taxing recycled sources of these metals, it was necessary to assume that CERCLA taxes would be imposed on the primary sources of supply of these metals. Then, the economic impacts of exempting or not exempting recycled sources of supply can be determined.

2.2 EXPENDITURE EXPERIENCE OF THE FUND WITH RESPECT TO COPPER, LEAD, ZINC OXIDE, AND ASSOCIATED SUBSTANCES

One important consideration in deciding whether to impose CERCLA taxes on substances is whether expenditures of the Fund have been made in response to problems caused, at least in part, by the substances. Indeed, this equity issue is at the root of many policy discussions of the rationale for, and the consequences of, imposing CERCLA taxes on different substances. Furthermore, the H Study specifically requests that the analysis of the effects of taxes and exemptions for copper, lead, and zinc oxide be evaluated in light of the Fund's experience with these substances.

However, determining the experience of the Fund with these substances is not a straightforward task. As Exhibits 2-1 through 2-3 illustrated, the metals under consideration here have many derivatives, some of which are taxed and some of which are not. Ultimately, to determine whether, from this equity standpoint, it is desirable to replace taxes on compounds of these metals with taxes on the metals themselves, the Fund experience with each of the derivatives and with the metals must be estimated.

There are two difficulties with determining the Fund experience with these metals and their derivatives. First, none of the existing sources of information on what substances are found at sites that have required (or will require) Fund expenditures allow for identification of substances below the level of, e.g., "copper and its compounds." Therefore, it is difficult to tell whether a particular finding of say "copper and its compounds" comes from a currently taxed or untaxed source, since the find could have been cupric oxide, not copper metal. Second, the concept of "expenditure experience of the Fund" is subject to interpretation, ranging from the sites where remedial actions have already occurred to the entire National Priorities List (NPL).

To attack the first problem, descriptions of sites at which Fund monies have been spent, or might be spent, have been consulted. These descriptions yield indications of whether the copper, for example, found at the site came from copper metal activities or from compounds of copper.

The second problem, that of determining the appropriate purview of the term "Fund experience," can be addressed by using several definitions of the scope of actual and potential Fund expenditures. Two alternatives are proposed and analyzed. Alternative 1, discussed in Section 2.2.1, is to use the NPL sites as a proxy for the "expenditure experience of the Fund." Alternative 2, discussed in Section 2.2.2, uses the records of historical and planned remedial and removal actions as a proxy for the expenditure experience of the Fund.

2.2.1 Alternative 1 - National Priorities List Sites as Proxy For Expenditure Experience of the Fund

NPL sites are a reasonable proxy for the substances that have caused and will cause Fund expenditures for several reasons. Fund resources have already been spent characterizing the NPL sites, some Fund monies have been spent carrying out or approving remedial or removal actions at NPL sites, and -- perhaps most significant -- these sites represent the universe of remedial actions likely to be undertaken. Hence, they are a reasonable proxy for the future expenditure experience of the Fund.

In the original ranking of these sites, in order to select the NPL set of sites, the Hazard Ranking System (HRS) employed information on both the substances present at each site, the media (air, water, etc.) in which they were found, and related data. This information can be used to determine what substances were found at the NPL sites. If copper, lead, or zinc, or their compounds are listed, then a more thorough study of the site records might determine whether the substance found is a metal or a compound of the metal.

In addition to the HRS data base, the Contract Laboratory Program (CLP) data base can be used to supplement NPL data. This data set contains information on not only the substances found at sites, but also their concentrations. The latter piece of information is potentially valuable in that higher concentrations of certain substances may increase the likelihood of Fund expenditures.

HRS Data Base Results

The frequency with which copper, lead, and zinc were reported at the 538 sites currently listed on the NPL was determined from the HRS data base. The occurrences of substances associated with copper, lead, and zinc ore processing, as described in Appendices A and B in the accompanying supplementary report, were also recorded. These substances were considered "associated" only when they were reported at the same sites as the metals with which they are found in ore processing (for example, cadmium, which may be associated with zinc ore processing, was counted only when it occurred simultaneously with zinc at a site). Exhibit 2-4 shows the number of NPL sites at which copper, lead, and zinc, their compounds, and associated substances were reported; the number of NPL mining sites at which they were reported; and the number of times they were reported in ground water, surface water, and air. Exhibit 2-5 shows the occurrences of copper and substances associated with copper ore processing; occurrences of lead and associated substances are presented in Exhibit 2-6; and Exhibit 2-7 shows occurrences of zinc and associated substances. Copper, lead, and/or zinc were reported at 182 sites, or 34 percent, of the 538 NPL sites. Lead, reported at 162 sites, is the second most frequently occurring chemical at NPL sites. Heavy metals, which may include lead and/or zinc, were reported at an additional 25 sites.

Copper, lead, and/or zinc were reported at 10 of the 12 NPL sites listed as mining sites in the HRS data base. Exhibit 2-8 shows the NPL mining sites where copper, lead, and/or zinc occur and the exempt and associated substances reported at each site.

It was not possible to determine from the HRS data base or from the CLP data base, discussed in the next section, whether copper, lead, or zinc were

EXHIBIT 2-4

COPPER, LEAD, ZINC, AND ASSOCIATED SUBSTANCES REPORTED
AT 538 UPDATED NATIONAL PRIORITIES LIST (NPL) SITES

Exempt Substance	Number Times Reported at Site	Frequency Relative to Other Substances 1/	Number of Times Reported at Mining Sites	Number of Times Reported in Groundwater	Number of Times Reported in Surface Water	Number of Times Reported in Air
Copper and Compounds	47	18	6	17	16	1
Copper Cyanide	1	--	0	0	0	0
Lead	162	2	9	77	64	7
Lead Chromate	1	--	0	0	0	0
Lead-Molybdenum	1	--	0	0	0	0
Zinc and Compounds	74	12	9	28	27	2
Zinc Cyanide	1	--	0	0	0	0
Associated Substances Reported at Same Sites						
Arsenic	15		3	9	6	0
Arsenic and Compounds	2		0	1	0	0
Cadmium	38		8	13	13	3
Calcium Chromate	1		0	0	0	0
Calcium Metasilicate	1		0	0	0	0
Cyanides (Soluble)	13		0	3	4	0
Iron and Compounds			4			
Manganese and Compounds	12		4	4	3	0
Mercury	11		0	6	4	1
Nickel and Compounds						
Selenium	2		0	1	0	0
Selenium and Compounds	1		0	0	0	0
Sodium and Compounds	1		0	0	0	0
Sulfate (Ion)	2		1	1	0	0

1/ To illustrate: lead is the second most frequently reported substance at updated NPL sites.

Source: ICF tabulation of Mitre Corporation, Hazard Ranking System (HRS) data base and Appendices A and B of the supplementary report.

EXHIBIT 2-5

COPPER AND ASSOCIATED SUBSTANCES REPORTED AT 538 UPDATED NATIONAL PRIORITIES LIST (NPL) SITES

Exempt Substance	Number Times Reported at Site	Frequency Relative to Other Substances 1/	Number of Times Reported at Mining Sites	Number of Times Reported in Groundwater	Number of Times Reported in Surface Water	Number of Times Reported in Air
Copper and Compounds	47	18	6	17	16	1
Copper Cyanide	1		0	0	0	0
Associated Substances Reported at Same Sites						
Arsenic	15		3	9	6	0
Arsenic and Compounds	2		0	1	0	0
Calcium Chromate	1		0	0	0	0
Iron and Compounds	8		3	2	1	0
Lead	36		5	10	14	0
Nickel and Compounds	13		0	3	6	0
Selenium	2		0	1	0	0
Selenium and Compounds	1		0	0	0	0
Sodium and Compounds	1		0	0	0	0
Zinc and Compounds	32		6	11	13	1
Zinc Cyanide	1		0	0	0	0

1/ To illustrate: lead is the second most frequently reported substance at updated NPL sites.

Source: ICF tabulation of Mitre Corporation, Hazard Ranking System (HRS) data base and Appendices A and B of the supplementary report.

EXHIBIT 2-6

LEAD AND ASSOCIATED SUBSTANCES REPORTED AT 538 UPDATED

NATIONAL PRIORITIES LIST (NPL) SITES

Exempt Substance	Number Times Reported at Site	Frequency Relative to Other Substances 1/	Number of Times Reported at Mining Sites	Number of Times Reported in Groundwater	Number of Times Reported in Surface Water	Number of Times Reported in Air
Lead	162	2	9	77	64	7
Lead Chromate	1		0	0	0	0
Lead-Molybdenum	1		0	0	0	0
Associated Substances Reported at Same Sites						
Calcium Metasilicate	1		0	0	0	1
Copper and Compounds	36		5	11	13	0
Nickel and Compounds	18		0	6	7	0
Sulfate (Ion)	2		1	1	0	0
Zinc and Compounds	58		8	21	24	2

1/ To illustrate: lead is the second most frequently reported substance at updated NPL sites.

Source: ICF tabulation of Mitre Corporation, Hazard Ranking System (HRS) data base and Appendices A and B of the supplementary report.

EXHIBIT 2-7

ZINC AND ASSOCIATED SUBSTANCES REPORTED AT 538 UPDATED NATIONAL PRIORITIES LIST (NPL) SITES

Exempt Substance	Number Times Reported at Site	Frequency Relative to Other Substances 1/	Number of Times Reported at Mining Sites	Number of Times Reported in Groundwater	Number of Times Reported in Surface Water	Number of Times Reported in Air
Zinc and Compounds	74	12	9	28	27	2
Zinc Cyanide	1		0	0	0	0
Associated Substances Reported at Same Sites						
Cadmium	38		8	13	13	3
Chloride (Ion)	1		0	0	1	0
Copper and Compounds	32		6	8	11	0
Copper Cyanide	1		0	0	0	0
Cyanides (Soluble)	13		0	3	4	0
Iron and Compounds	9		4	4	2	0
Lead	59		8	26	26	4
Manganese and Compounds	12		4	4	3	0
Mercury	11		0	6	4	1

1/ To illustrate: lead is the second most frequently reported substance at updated NPL sites.

Source: ICF tabulation of Mitre Corporation, Hazard Ranking System (HRS) data base and Appendices A and B of the supplementary report.

EXHIBIT 2-8

NPL MINING SITES WHERE COPPER, LEAD, AND/OR ZINC ARE REPORTED

Site Name	Location	NPL Rank	Copper, Lead and/or Zinc and Associated Substances Reported	Substance used to Score Toxicity/Persistance
United Nuclear Corp.	Church Rock, NM	381	Lead, arsenic, cadmium, mercury, sulfate (ion)	Groundwater: Lead Surface water: lead Air: Uranium & compounds
Tar Creek	Ottawa County, OK	48	Lead, zinc and compounds, iron and compounds, cadmium	Groundwater: Cadmium Surface water: Cadmium Air: Not scored
Cherokee County	Cherokee County, KS	49	Lead, zinc and compounds, cadmium	Groundwater: Cadmium Surface water: Cadmium Air: Not Scored
California Gulch	Leadville, CO	59	Copper and compounds, lead, zinc and compounds, cadmium, iron and compounds, manganese and compounds	Groundwater: Cadmium Surface water: Cadmium Air: Not Scored
Central City, Clear Creek	Idaho Springs, CO	126	Copper and compounds, lead, zinc and compounds, iron and compounds, manganese and compounds	Groundwater: Cadmium Surface water: Cadmium Air: Not Scored
Anaconda Smelter-Anaconda	Anaconda, MT	42	Lead, zinc and compounds, cadmium, arsenic, manganese and compounds	Groundwater: Arsenic Surface water: Arsenic Air: Arsenic
Milltown Reservoir Sediments	Milltown, MT	198	Copper and compounds, lead, zinc and compounds, manganese and compounds	Ground water: Arsenic Surface water: Arsenic Air: Not Scored
Silver Bow/Deer Lodge	Silver Bow Creek, MT	21	Copper and compounds, lead, zinc and compounds, cadmium	Groundwater: Arsenic Surface water: Arsenic Air: Not Scored
Celtor Chemical Works	Hoopa, CA	383	Lead, zinc and compounds, copper and compounds, cadmium, arsenic, iron and compounds	Groundwater: Lead Surface water: Lead Air: Not Scored
Iron Mountain Mine	Redding, CA	57	Copper and compounds, zinc and compounds, cadmium	Groundwater: Cadmium Surface water: Cadmium Air: Not Scored

Source: ICF tabulation of Mitre Corporation, Hazard Ranking System (HRS) data base.

present in metallic form at a site, or what compounds of each metal were present. (Copper is listed in the HRS data base as "copper and compounds," zinc as "zinc and compounds," and lead simply as "lead;" a few compounds of each are also listed.) Because some copper, lead, and zinc compounds currently are taxed, an attempt was made to assess the likelihood of copper, lead, or zinc occurring in the form of taxed compounds at the NPL sites based on descriptions of the waste sites and the types of wastes found at each site given in the HRS data base and EPA's Waste Site Descriptions. As shown in Exhibit 2-9, it is unlikely that taxed compounds are present at 73 of the sites, or 40 percent of the 182 sites where copper, lead, and/or zinc are found. Wastes at these sites included mining, smelting, and metal processing wastes; organic wastes; and wastes from known processes which do not involve the taxed compounds. It is likely that taxed compounds may be present at 35 sites, or 19 percent of the total. The wastes at many of these sites include paints, pigments, or paint sludges, which may contain taxed compounds. A few other sites are included because lead batteries (containing lead oxide) are found or galvanizing wastes are included (zinc chloride is used in galvanizing). A few sites were included because the wastes were generated by chemical companies whose products were unknown; it is possible that taxed compounds might be produced or used by these companies. An additional 26 sites (14 percent) contain industrial wastes which could possibly include taxed compounds; the remaining 48 sites were not described in enough detail to make any judgment.

Contract Laboratory Program Data Base

The results of inorganic sample analysis were examined for 73 NPL sites where laboratory test results were available as of June, 1983 as part of the Contract Laboratory Program. The tests were performed on both soil and water samples. Results of this testing were made available to ICF by VIAR and Company, Alexandria, Virginia, manager of the Contract Laboratory Program. The results were for sites where laboratory analysis was recent and in conformity with current, standard testing procedures. ICF entered these results into a data base. The total number of samples reviewed for the 73 sites was 1,200 (800 water samples and 400 soil samples).[1]

Exhibits 2-10 and 2-11 summarize the sampling data for the three exempt and 13 associated substances in water and soil, respectively. Several key findings emerge. The three exempt substances individually exceed detectable limits in 85-95 percent of all water samples and in 96-99.7 percent of all soil samples. Extremely high percentages of the samples analyzed for associated substances also showed that these were present above detectable limits.

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[1]The exact number of sites represented by these samples cannot be known. The samples were organized into 73 cases, each case consisting of samples collected at approximately the same location. A case corresponds generally, but not exactly, to a site.

EXHIBIT 2-9

POSSIBLE PRESENCE OF TAXED COMPOUNDS OF COPPER, LEAD, AND ZINC AT UPDATED NPL SITES[1]

Likelihood of Occurrence of Taxed Compounds	Number of Sites	Types of Wastes
Unlikely	73	Mining, smelting, metal processing. Oil processing. Organics, solvents. Wastes from processes not involving taxed compounds.
Likely	35	Paints, pigments, paint sludges, dyes. Lead batteries. Chemical companies (if producers of taxed compounds or if products unknown). Galvanizing.
Possible	26	Unspecified industrial wastes.
Unknown	48	Insufficient information for determination.

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[1] Taxed compounds of copper, lead, and zinc are cupric sulfate, cuprous oxide, lead oxide, zinc chloride, and zinc sulfate.

Sources: ICF, from MITRE Corporation, Hazard Ranking System Data Base and EPA, Waste Site Descriptions.

EXHIBIT 2-10

ANALYSIS OF WATER SAMPLES FROM NATIONAL PRIORITIES LIST SITES

	(1) Water Samples	(2) Not Analyzed a/	(3) Less Than Detectable Limit	(4) Greater Than Detectable Limit	(5) (4) As Percentage of All Samples Analyzed	(6) (4) As Percentage of All Cases b/	(7) Mean Value of (4) in ug/l	(8) Median Value of (4) in ug/l
Exempt Substances:								
Zinc	800	51	38	711	95	97	1,377.1	91.0
Copper	800	82	102	616	86	89	122.6	50.0
Lead	800	40	114	646	85	92	218.2	5.0
Associated Substances:								
Antimony	800	90	148	562	79	77	26.9	20.0
Arsenic	800	77	103	620	86	85	41.9	10.0
Cadmium	800	46	123	631	84	97	4.2	1.0
Calcium	800	752	2	46	96	12	10,684.2	82.0
Chloride	800	765	0	35	100	5	17,432.5	90.0
Chromium	800	83	87	630	88	93	105.1	100.0
Iron	800	29	33	738	96	99	37,011.2	396.5
Manganese	800	26	50	724	94	95	2,106.6	139.5
Mercury	800	97	139	564	80	82	1.2	0.2
Nickel	800	65	99	636	87	89	269.5	40.0
Selenium	800	98	128	574	82	79	3.4	2.0
Sodium	800	758	0	42	100	10	28,563.7	160.5
Vanadium	800	86	110	604	90	81	286.3	200.0

a/ A case is a series of samples collected at the same approximate location. Cases correspond generally, but not precisely, to sites; the 203 NPL sites for which samples have been collected to date represent 250 cases.

b/ According to Viar & Company, analysis was attempted for all listed substances, but not possible for the number listed in this column. A common reason was interference caused by the presence of other elements.

Source: ICF analysis of data from 73 case studies performed as part of the Contract Laboratory Program.

EXHIBIT 2-11

ANALYSIS OF SOIL SAMPLES FROM NATIONAL PRIORITIES LIST SITES

	(1) Water Samples	(2) Not Analyzed a/	(3) Less Than Detectable Limit	(4) Greater Than Detectable Limit	(5) (4) As Percentage of All Samples Analyzed	(6) (4) As Percentage of All Cases b/	(7) Mean Value of (4) in mg/kg	(8) Median Value of (4) in mg/kg
Exempt Substances:								
Zinc	400	10	1	389	99.7	100	132.3	13.8
Copper	400	80	12	308	96	87	29.3	8.9
Lead	400	12	5	383	99	82	175.7	9.0
Associated Substances:								
Antimony	400	114	23	233	81	72	3.3	1.0
Arsenic	400	100	13	287	96	85	4.9	1.6
Cadmium	400	57	9	334	97	90	1.9	0.2
Calcium	400	335	0	6	25	10	1,217.6	450.0
Chloride	400	364	0	36	100	5	647.0	245.0
Chromium	400	104	11	285	99	90	26.7	2.8
Iron	400	9	0	391	100	100	6,128.3	540.0
Manganese	400	11	0	389	100	100	175.3	99.0
Mercury	400	149	13	238	95	79	0.4	0.02
Nickel	400	95	11	294	96	87	26.0	6.6
Selenium	400	150	18	232	93	69	0.3	0.1
Sodium	400	351	0	49	100	8	348.8	120.0
Vanadium	400	145	10	245	96	82	36.3	20.0

a/ Cases defined on Exhibit 2-2.

b/ Explained on Exhibit 2-2.

Source: ICF analysis of data from 73 case studies performed as part of the Contract Laboratory Program.

The second key finding is that the concentrations of both exempt and associated substances in water and soil samples are widely scattered, with most samples showing low values but a significant fraction showing extremely high values. This conclusion can be drawn after comparing the values represented by the mean concentrations (column 7) and the median concentrations (column 8), respectively.[2] If the concentration data are normally distributed, the data would be well-centered about the mean, with the mean values closely approximating the median values. However, taken as a whole, the mean values are typically many multiples of median values (see Exhibit 2-12). These data indicate that while half of the samples are below the median, a sufficient fraction of the samples occur with very high values to shift the mean to many multiples of the median.

To investigate further the relationship between concentrations in the soil and toxicity, the distribution of the concentrations in water have been evaluated relative to National Interim Drinking Water (NIDW) standards, established under the Safe Drinking Water Act. Maximum Contaminant Levels (MCLs) were established for one of the three exempt substances -- lead -- and five of the associated substances -- arsenic, cadmium, chromium, mercury, and selenium. Exhibit 2-13 presents the distributions of samples relative to MCLs for these substances. As can be seen in the exhibit, with the exception of lead, 90 to 96 percent of the contaminants in the water samples were below the MCL, with the substantial portion of the remainder falling within the category of 1 to 5 times the MCLs. In the case of lead, however, a substantial percentage of samples -- 61 percent -- were above the MCL, with 34 percent of all values 5 or more times the MCL. Caution should be taken in interpreting these findings, however, as information on the sampling procedures, types and locations of samples relative to drinking water supplies are not available. They do, however, indicate a major potential for contamination of water supplies. Because of the absence of sufficient information, similar analyses could not be performed for soil samples.

Finally, there is a high correlation between occurrence of exempt substances and associated substances at NPL sites. As shown in Exhibit 2-14, over half of the samples with at least one exempt substance present also had 10 or more associated substances present.[3] More than 97 percent of the samples with at least one exempt substance had one or more associated substances detected above background concentrations.

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[2]The mean defines the average concentration of all samples. The median defines the middle concentration: 50 percent of the concentrations are above and 50 percent of the concentrations are below the median.

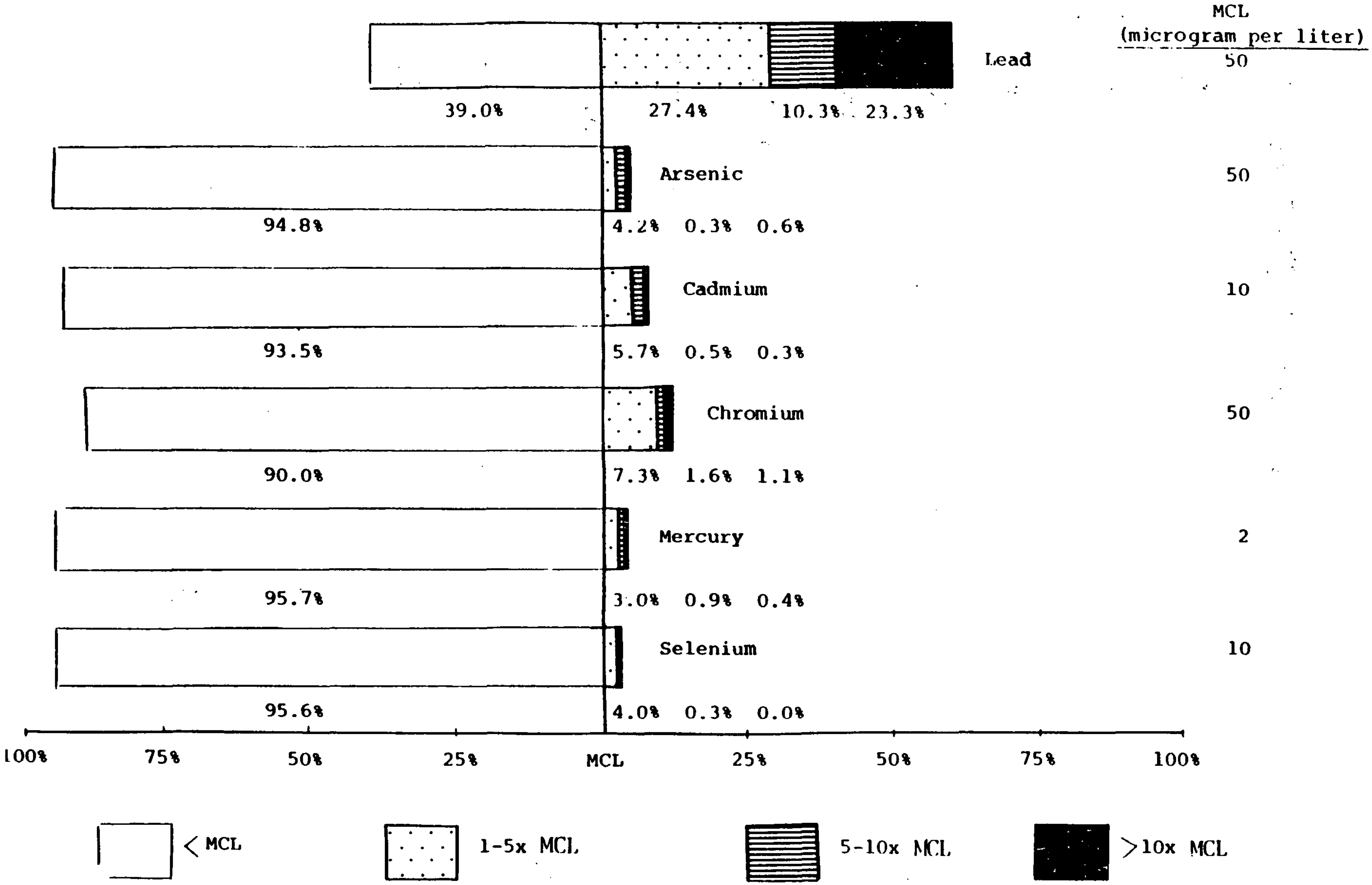
[3]Because each of the exempt substances was found in high percentages of the samples and because of the large overlap in substances associated with each exempt substance, similar analyses by individual exempt substance were not performed.

EXHIBIT 2-12

RATIOS OF MEAN TO MEDIAN CONCENTRATIONS OF EXEMPT AND ASSOCIATED SUBSTANCES IN WATER AND SOIL SAMPLES TAKEN AT SELECTED NPL SITES

	Ratios	
	Water	Soil
Exempt Substances		
Zinc	15.1	9.6
Copper	2.5	3.3
Lead	43.6	19.5
Associated Substances		
Antimony	1.3	3.3
Arsenic	4.2	3.7
Cadmium	4.2	9.5
Calcium	130.3	2.7
Chloride	193.6	2.6
Chromium	1.1	9.5
Iron	93.5	11.3
Manganese	15.1	1.8
Mercury	6.0	20.0
Nickel	6.8	3.9
Selenium	1.7	3.0
Sodium	178.0	2.9
Vanadium	1.4	1.8

Distribution of Water Samples
Above Maximum Contaminant Levels

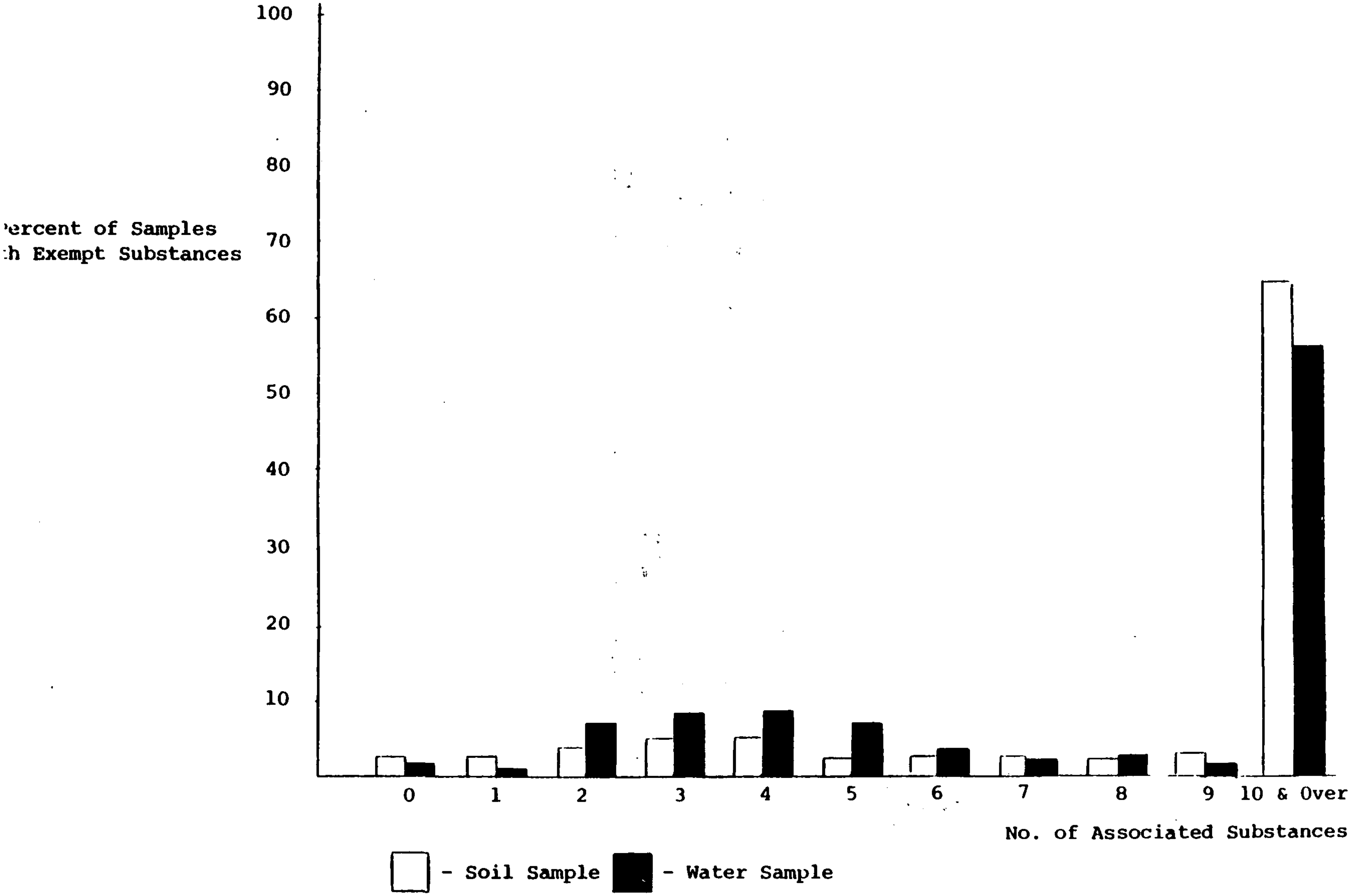


Source: ICF analysis of data from the Contract Laboratory Program.

EXHIBIT 2-13

EXHIBIT 2-14

Distribution of Samples with Exempt Substance(s)
By Number of Associated Substances Also Present



2.2.2 Alternative 2 - Historical and Planned Remedial and Removal Actions as Proxy for Expenditure Experience of the Fund

Although the NPL represents a reasonable proxy for expenditure experience of the Fund, a narrower definition of "expenditure experience" might be proposed which would restrict it to remedial and removal actions carried out or approved under the Fund. Because, the number of historical and planned remedial actions is not large (six remedial actions have been completed and Records of Decision exist for an additional 26), this proxy may not provide a sufficient sample to assess the true extent of the problem. Nevertheless, this narrower proxy is presented for completeness. This section uses the following for this narrower proxy:

- Completed remedial actions;
- Planned remedial actions; and
- Historical removal actions.

Remedial action has been taken at six waste disposal sites. These sites are listed in Exhibit 2-15. Copper, lead, and zinc were not reported at four of these sites, according to the site descriptions provided by the Superfund Hotline. One site (Walcott Chemical Warehouse) was remedied by the owner, and no information is available according to EPA Region IV, where the site is located. Information has not yet been obtained on the sixth site (Luminous Processes).

An analysis of EPA's Records of Decision (RODs) for planned remedial actions at NPL sites shows that copper, lead, and/or zinc are present at seven of the 26 sites for which there are Records of Decision, or 27 percent of the total. These seven sites are shown in Exhibit 2-16. One of these sites, Celtor Chemical Works, is an abandoned sulfide ore processing plant contamined with copper, zinc, and cadmium. Information on concentrations is not currently available.

Data from the Removal Tracking System, which summarizes removals and planned removals, show that copper, lead, and/or zinc have been involved in a number of removal actions. Exhibit 2-17 presents immediate and planned removals for 1981 to 1983 which have included copper, lead, and/or zinc. Seventeen removals, or eight percent of the 210 immediate removals approved during this period, involved one or several of these substances, with lead mentioned in 13 of the removals. An additional 10 removals involved heavy metals and three more involved unspecified metals. Lead was also included in one of the 14 planned removals, while heavy metals and unspecified metals were each included in two planned removals.

2.3 SUMMARY

Copper, lead, and/or zinc are found at about one third of the NPL sites. These substances have also been found in a number of cases where removal actions have been approved, and at a number of sites where there have been Records of Decision. Using either the NPL list as a proxy for expenditure of the Fund or a more restricted definition, this analysis indicates that Fund

EXHIBIT 2-15

REMEDIAL ACTIONS WHICH HAVE BEEN COMPLETED AS OF JUNE 1984

Name of Site	Types of Wastes
Chemical Metals Industry, Baltimore, MD	Cyanide, organic solvents, acid
Walcott Chemical Warehouse, Greenville, MS	Information not available - cleaned up by owner
Luminous Processes, Athens, GA	
Butler Tunnel, Pittson, PA	Trichloroethylene, cyanide, toluene, xylene, dichlorobenzene
Chemical Minerals, Cleveland, OH	1,1,1-Trichloroethane, toluene, perchloroethylene, chromic acid, antimony chloride
Gratiot County Golf Course, St. Louis, MI	PBB's, Tris, benzene

Sources: Superfund Hotline, CERCLA Docket, EPA Region IV.

EXHIBIT 2-16

SITES WITH COPPER, LEAD, AND/OR ZINC FOR WHICH THERE ARE RECORDS OF DECISION[1]

Name of Site	Cost of Approved Clean-up Plan (Thousand Dollars)
Burnt Fly Bog, Marlboro Township, New Jersey	7,000
Bruin Lagoon, Bruin Borough, Pennsylvania	
New Brighton/Arden Hills, Minnesota	181
Celtor Chemical Company, Hoopa, California	340
Lipari Landfill, Pitman, New Jersey	2,000
Price Landfill, Pleasantville, New Jersey	
Berlin and Farro, Swartz Creek, Michigan	181

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[1]EPA, Office of Solid Waste and Emergency Response, Records of Decision, Remedial Alternative Selection.

EXHIBIT 2-17

APPROVED IMMEDIATE REMOVALS AND PLANNED REMOVALS INVOLVING COPPER, LEAD, AND ZINC, 1981-1983

Metal	Number of Immediate Removals	Total Cost Ceiling 1/ (thousand dollars)	Number of Planned Removals	Total Cost Ceiling (thousand dollars)
Copper	1	86.7	0	0
Lead	11	2,205.0	1	350
Zinc	2	446.4	0	0
Lead and Copper	1	350.0	0	0
Lead and Zinc	2	735.5	0	0
Subtotal	17	3,823.6	1	350
Heavy Metals	10	1,905	2	423
Unspecified Metals	3	213	2	659
Subtotal	13	2,118	4	1,082
TOTAL	30	5,941.6	5	1,432

1/ Total of approved cost ceilings for each removal.

Source: Analysis of ERD Removal Request Processing, prepared by Headquarters Technical Assistance Team (TAT).

expenditures have been made on releases involving copper, lead, zinc, and their derivatives. Furthermore, as demonstrated in Exhibit 2-9, it is likely that many of these releases result from currently untaxed sources of copper, lead, and zinc.

3. METHODOLOGY FOR ANALYZING THE ECONOMIC IMPACT OF COPPER, LEAD, AND ZINC OXIDE EXEMPTIONS AND OF TAXING RECYCLED METALS

This chapter describes the methodology developed to examine the economic impact of taxing copper, lead, zinc oxide, and recycled metals under CERCLA. The methodology is designed to analyze the ability of an affected industry to bear a tax and the potential stimulus to recycling that could be provided by a tax exemption. The economic analysis described in this and succeeding chapters is tailored to the needs of the H and I Studies. Accordingly, the emphasis is on the following economic factors: (1) output and price effects on the industries studied; (2) the economic health and vulnerability of the industries; and (3) the effects on the mix of imports and domestic production.

Two major steps are involved in the methodology:

- Developing a brief economic profile of the relevant industry to identify its important structural and performance characteristics; and

- Developing a partial equilibrium demand-supply model to estimate the effect of a CERCLA tax on (1) the quantity of U.S. primary production; (2) the quantity of U.S. recycled production; (3) the quantity of U.S. imports; and (4) the price of the metal.

The first section of this chapter describes the scope of the industry profiles. The second section presents the quantitative method that has been developed to estimate the economic impact of taxing copper, lead, zinc oxide, and recycled metals. The final section of this chapter describes the selection of recycled metals for analysis in this report -- copper, lead, and zinc.

3.1 DESCRIPTION OF INDUSTRY PROFILES

Chapters 4, 5, and 6 present the results of the economic analysis of the impact of taxing copper, lead, zinc oxide, and recycled metals (copper, lead, and zinc) under CERCLA. To place the results of the economic analysis in perspective, these chapters begin with brief profiles of the copper, lead, zinc, and zinc oxide industries. The zinc and zinc oxide profiles are presented together, as they are closely related industries. The intent of the profiles is to provide basic background information rather than an exhaustive analysis of all facets of an industry. These profiles are particularly oriented towards understanding the "economic health" of these industries, both over the short and long-term. Accordingly, the profiles are organized in the following manner:

(1) Introduction -- characteristics of the substance, its uses and strategic value;

(2) Demand for the substance -- consumption and price trends for 1978-1982 by industry, important long-term trends in consuming sectors;

(3) Supply of the substance -- world and U.S. reserves, production processes, trends in primary and secondary production and U.S. imports in 1978-1982; and

(4) Industry structure and performance -- number of companies involved in primary and secondary production, recent performance of these companies in terms of profits/losses, outlook for the industry and review of foreign competition, environmental concerns, and competition from substitute products.

Each profile supplies the information necessary to place our analysis of economic impacts in its proper context. Data and other information in the profiles were obtained from the U.S. Bureau of Mines, the U.S. Industrial Outlook for 1983 and 1984, and publications such as World Metal Statistics. As stated above, the zinc oxide industry profile is presented as part of an overall profile of the zinc industry, as little data are easily available on the zinc oxide industry alone, and some zinc producers are also important zinc oxide producers.

3.2 DESCRIPTION OF ECONOMIC FRAMEWORK

The industry profiles, together with the results of a comprehensive literature search on the economics of the mineral industries, have been used to develop a method for quantitatively estimating the output and price effects of a CERCLA tax on these substances. Two types of CERCLA taxes can be examined by the framework: (1) a tax on U.S.-produced primary, U.S.-produced recycled, and imported forms of a metal (or one of its chemical derivatives, such as zinc oxide); and (2) exempting from taxation the U.S. produced recycled metal while taxing the other sources. This demand-supply framework is described in qualitative terms below. Appendix C in the supplementary report presents a more detailed discussion of the derivation of the framework, including the algebraic form of the model.

Before developing the framework, an effort was made to review past economic studies of the mineral industries, particularly the U.S. copper industry, and their alternative modeling approaches. It was determined that previous econometric models of the mineral industries were either not well-suited for the analysis of a CERCLA tax or tax exemption or could not be readily reproduced to perform the analysis needed. For example, the models required very extensive time-series data on a large number of variables, and have not been very successful in forecasting industry performance. Moreover, despite the extensive research on the industries that was done in support of these models, there are serious shortcomings in the availability of reliable data for this analysis. These shortcomings include:

- The estimation periods of supply and demand elasticity coefficients are not recent; most of the models, especially of the copper industry, were fitted to 1950-1970 data;[1]

- There is considerable variability in supply and demand elasticity estimates due to different estimation techniques;[2]

- Little quantitative research has been done on measuring the extent to which the primary and recycled forms of a metal are substitutes for one another; and

- Existing models, despite their often dynamic nature, have not been able to project future prices with sufficient accuracy.

Given these empirical considerations, a framework was developed that is simple enough to sensibly employ the available data and comprehensive enough to reliably represent the copper, lead, zinc, and zinc oxide industries for purposes of analyzing the impact of a CERCLA tax or tax exemption. The interactions of the framework's supply and demand components are generally consistent with those modeled in existing econometric studies of primary metals industries.[3] The assumptions underlying the framework are spelled out below.

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[1]The principal exception appears to be an econometric model of primary commodity markets by the World Bank that recently estimated various elasticities over the 1976-1980 period. See World Bank, The Outlook for Primary Commodities (World Bank: Washington, D.C., 1983), pp. 134-135.

[2]This variability for copper is briefly discussed in Raymond F. Mikesell, The World Copper Industry (Johns Hopkins University Press: Baltimore, 1979), pp. 154-186. Elasticity of demand is a number indicating how responsive consumers are to price changes. The elasticity of demand coefficient reflects the percent change in quantity demanded resulting from a one percent change in price. The concept of elasticity of supply is similar to elasticity of demand. It measures the responsiveness of producers to price changes and is defined as the percentage change in quantity supplied resulting from a one percent change in price. Demand and supply curves which are relatively elastic are relatively "flat," indicating greater than one percent quantity changes for each one percent price change.

[3]Franklin M. Fisher, Paul H. Cootner, Martin N. Baily, "An Econometric Model of the World Copper Industry," The Bell Journal of Economics and Management Science (A.T.&T.: New York, 1972), Vol. 3, No. 2, pp. 568-609; Kenneth T. Wise, "The Effects of OSHA Regulations on the U.S. Lead Industry: An Economic Impact and Econometric Modeling Analysis," Ph.D. Thesis, Department of Economics, Massachusetts Institute of Technology, December 1978; and S. Gupta, "An Econometric Analysis of the World Zinc Markets," Empirical Economics, Vol. 7, 1982, p. 227.

3.2.1 Assumptions

The framework developed for this analysis rests on several assumptions:

- Perfect competition exists among producers and among consumers;

- The U.S. primary, U.S. recycled, and imported forms of copper and of lead are perfect substitutes for a significant share of consuming industries, and, thus, can be viewed as a market for a homogeneous good in the relevant range of price and quantity variation;[4]

- Demand for a metal (or one of its derivatives, such as zinc oxide) equals total supply from all sources; and

- The relevant time period for analysis is the long run, i.e., after all short-run adjustments have taken place.[5]

The demand-supply framework is illustrated in Exhibit 3-1.[6] Because the framework is a partial equilibrium model, it estimates effects on the copper industry, for example, without allowing for changes in other sectors of the economy (including changes in the prices of substitute products, such as aluminum). In addition, the framework does not estimate effects on individual "downstream" markets, such as the markets for electric motors, power generators, fans, transformers, and electrical lighting equipment that require copper as an input. To analyze potential effects on individual downstream

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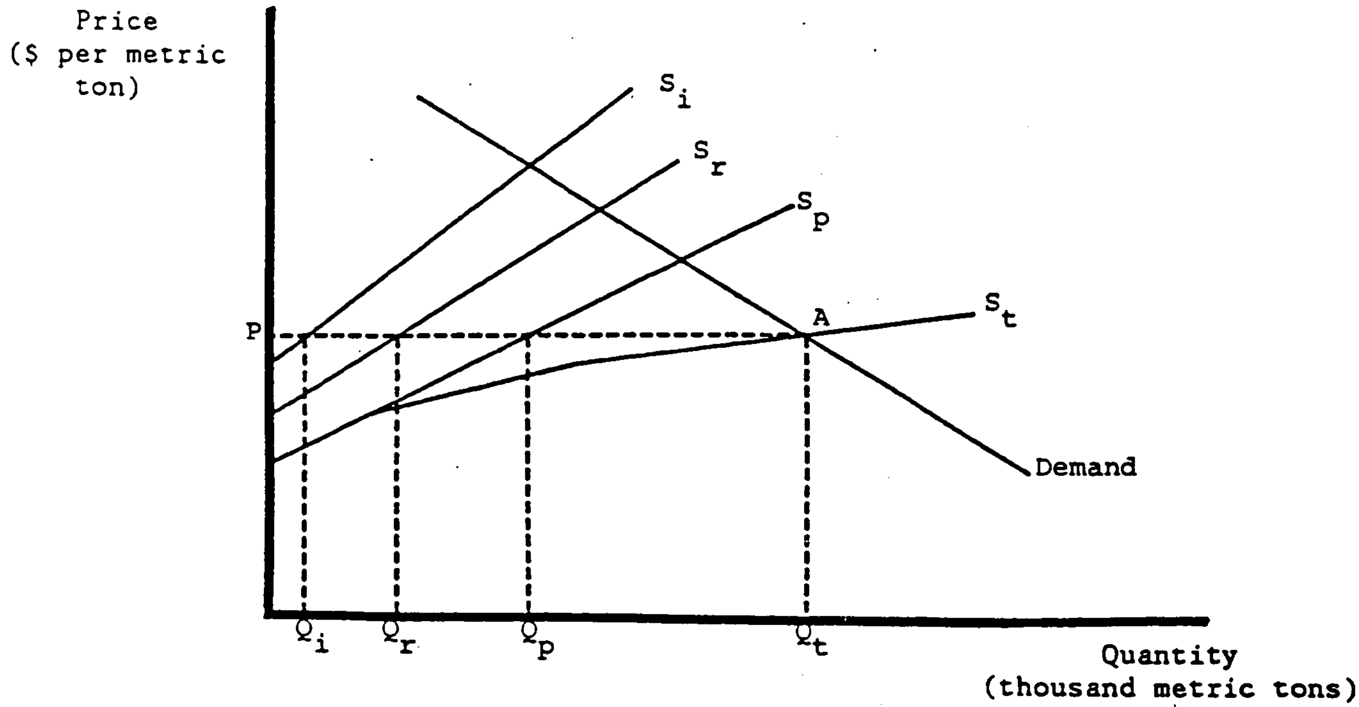
[4]Zinc recovered from old scrap technically cannot be refined to as pure a state as the metal refined from ore and, therefore, it is not substitutable for most applications of primary zinc. However, all that is required for the assumption of perfect substitutability to be valid for this modeling of zinc is that the uses to which some demanders put zinc allow either the recycled form or the primary form to be used. It is within the relevant range of price and quantity variation that the assumption must hold. There is sufficient evidence to suggest that enough demanders can switch from primary to recycled zinc so that the assumption is warranted for zinc as well.

[5]Long-run elasticity coefficients are used because the primary interest of those proposing a tax exemption for recycled metals has been to bring about long-run changes in how the nation uses materials. Consequently, the relevant time period for analysis is the long-run. However, if suppliers and consumers view a CERCLA tax or tax exemption for recycled metals as a temporary phenomenon, then short-run elasticity coefficients would be more appropriate. In general, demand and supply are more inelastic in the short run, except for scrap and for industries with large excess capacity.

[6]The framework can be applied for any metal that satisfies the above assumptions.

EXHIBIT 3-1

ILLUSTRATION OF THE ECONOMIC FRAMEWORK
BEFORE THE IMPOSITION OF A CERCLA TAX



Note: The subscripts i, r, p, and t on the supply schedules refer to the amount of imported, U.S. recycled (old scrap), U.S. primary, and total copper supplied in the U.S., respectively. Linear demand and supply schedules are presented in this exhibit for simplicity. The framework approximates the effect of a CERCLA tax by assuming the demand and supply schedules are linear in the relevant range of price and quantity variations. Such linear estimation techniques have also been used in other studies of the copper industry; see, for example, Charles River Associates, Inc., Policy Implications of Producer Country Supply Restrictions: The World Copper Market (C.R.A.: Cambridge, 1976), for National Bureau of Standards, PB-264 389.

products would require a comprehensive econometric model beyond the scope of this project. Furthermore, the legislative histories of CERCLA Sections 301(a)(1)(H) and (I) appear to indicate that most concern has been expressed over potential first-order effects on metals themselves.

The first-order effects of a CERCLA tax are measured by the framework in terms of changes in quantities demanded and supplied, and prices. Potential implications for other important variables such as employment, competitiveness, and the macroeconomy are not estimated. To estimate mathematically the effect of a CERCLA tax on these other variables would require the development of an econometric model that incorporates the complex interdependencies within the copper industry. Such a model may not be well-suited for analyzing the impact of a tax where the effects are likely to be small under a reasonable range of assumptions.

An economic factor that the framework does not explicitly take into consideration is the long-run interdependence between the supply of a primary metal and the supply of its recycled counterpart from old scrap. This supply interdependence exists because the more primary metal that is produced, the more such material is available in the future for recycling. We believe that this interdependence is not likely to be a significant omission in the present analysis because of the relatively small changes in the availability of metal that can be recycled in the future induced by the CERCLA tax rates analyzed here. Therefore, this dynamic effect probably is not important when there are relatively small changes in prices and quantity demanded.

3.2.2 Starting Point -- Equilibrium of Demand and Supply

Exhibit 3-1 represents the framework's starting point: an equilibrium in the market for a metal, say copper. The intersection of supply with demand at A represents the summation of three separate supply schedules: the supply of primary copper by U.S. producers, the supply of recycled copper by U.S. producers, and the supply of copper imported by the U.S. (both primary and recycled forms).[7] There are three supply schedules shown in the exhibit

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[7] For purposes of this analysis, the amount of primary copper supplied by U.S. producers refers to U.S. production of refined primary copper from both domestic and imported ores. The amount of recycled copper supplied by U.S. producers refers to U.S. production of old scrap (refined and unrefined) copper. The amount of net imports of copper by the U.S. refers to both primary and recycled forms of refined copper. Net imports of recycled copper are included with net imports of primary copper because a CERCLA tax would be applied to all imports, making imported recycled copper, effectively, imported primary copper in the context of this analysis. Currently, CERCLA tax treatment of imported products is the same as for products that are domestically produced.

corresponding to the three main sources of copper supply.[8] There is one demand schedule, however, because under the assumption of perfect substitution, a significant number of copper users are indifferent between the U.S. primary, U.S. recycled, and imported forms of copper in the relevant range of price variation.

This assumption of perfect substitution is well-founded for copper. For example, according to Bonezar and Tilton in 1975, "Secondary copper ... is a perfect substitute for primary copper."[9] In addition, a study of the U.S. copper industry by Charles River Associates, Inc. in 1970 noted that "... Secondary refined copper is physically equivalent to a corresponding grade of virgin refined copper."[10]

3.2.3 Imposition of a CERCLA Tax

Exhibits 3-2 and 3-3 show the demand-supply apparatus at work for estimating the impact of imposing a CERCLA tax on copper. Exhibit 3-2 illustrates the output and price effects of a tax on the U.S. primary, U.S. recycled, and imported forms of copper. Exhibit 3-3 portrays the output and price effects of a CERCLA tax on U.S. primary and imported copper only, with a tax exemption for U.S. recycled (old scrap) copper.

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[8] There is also a fourth supply schedule for new scrap collections. Because new scrap supply is not found in most cases to be measurably influenced by price, but rather is influenced primarily by total consumption, it is not helpful to present graphically this supply schedule when considering the impact of a price increase caused by a tax. However, this supply schedule is incorporated in the framework, when appropriate, and is described in Appendix C in the supplementary report.

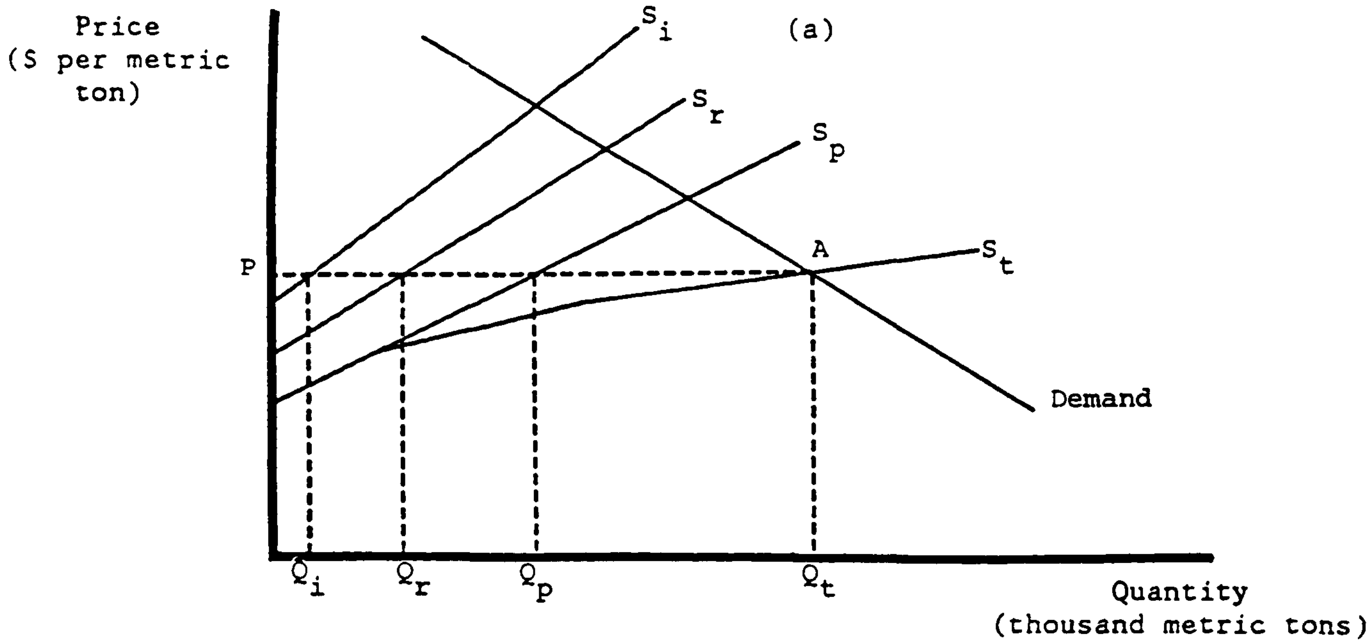
[9] Elizabeth S. Bonezar, John E. Tilton, An Economic Analysis of the Determinants of Metal Recycling in the United States: A Case Study of Secondary Copper (Pennsylvania State University: Pennsylvania, 1975), for the U.S. Bureau of Mines, PB-245 832, p. 49.

[10] Charles River Associates, Inc., Economic Analysis of the Copper Industry (C.R.A.: Cambridge, 1970), for U.S. General Services Administration under contract GS-00-DS-(P)-85005, p. 40. The report also noted that:

> Technically, the conclusion is that the cross-elasticity of demand for any two types of copper [refined copper, scrap, or alloy ingot] is infinite. The essential basis of the conclusion is that it is always possible to convert one type of copper to another. Hence, at equilibrium, the prices of any two types of copper cannot differ by more than the costs of converting one to another, or the difference in the costs of using the two, whichever is smaller. At this differential in price, then, substitution will go on freely. (Page 41.)

EXHIBIT 3-2

IMPOSITION OF A CERCLA TAX ON
U.S. PRIMARY, U.S. RECYCLED, AND IMPORTED COPPER



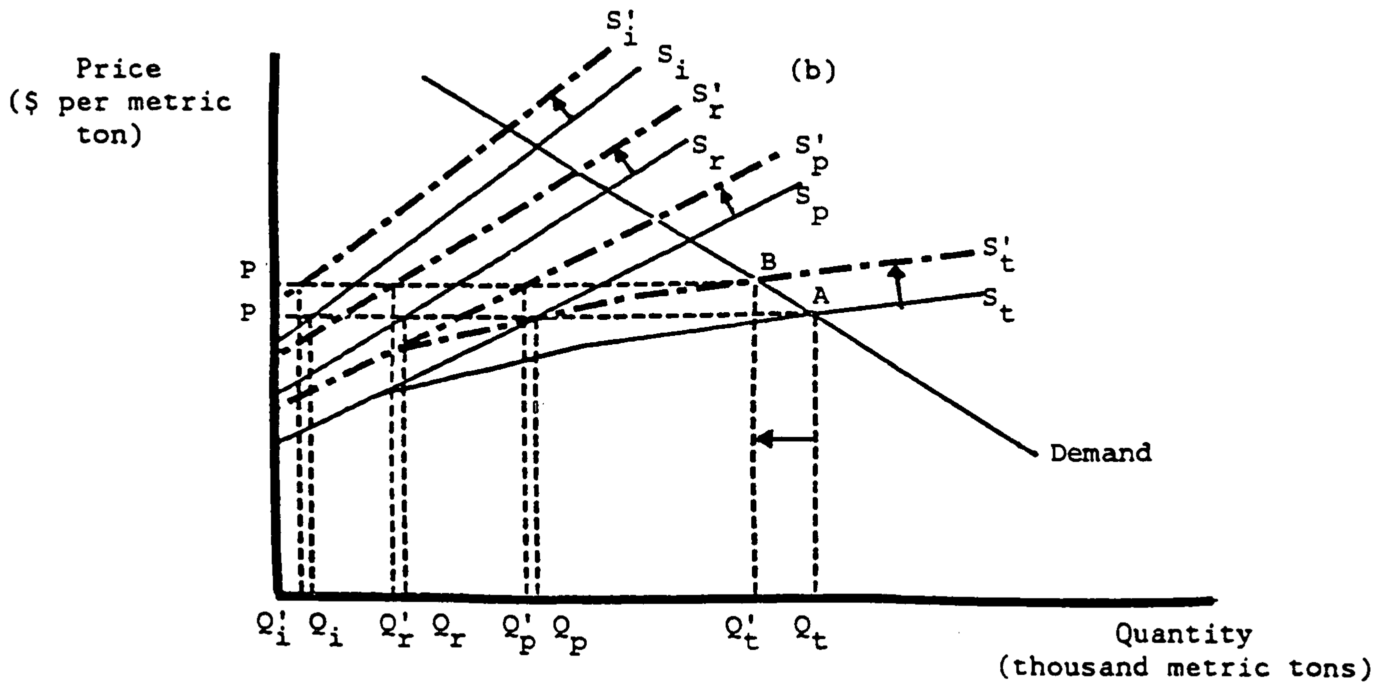
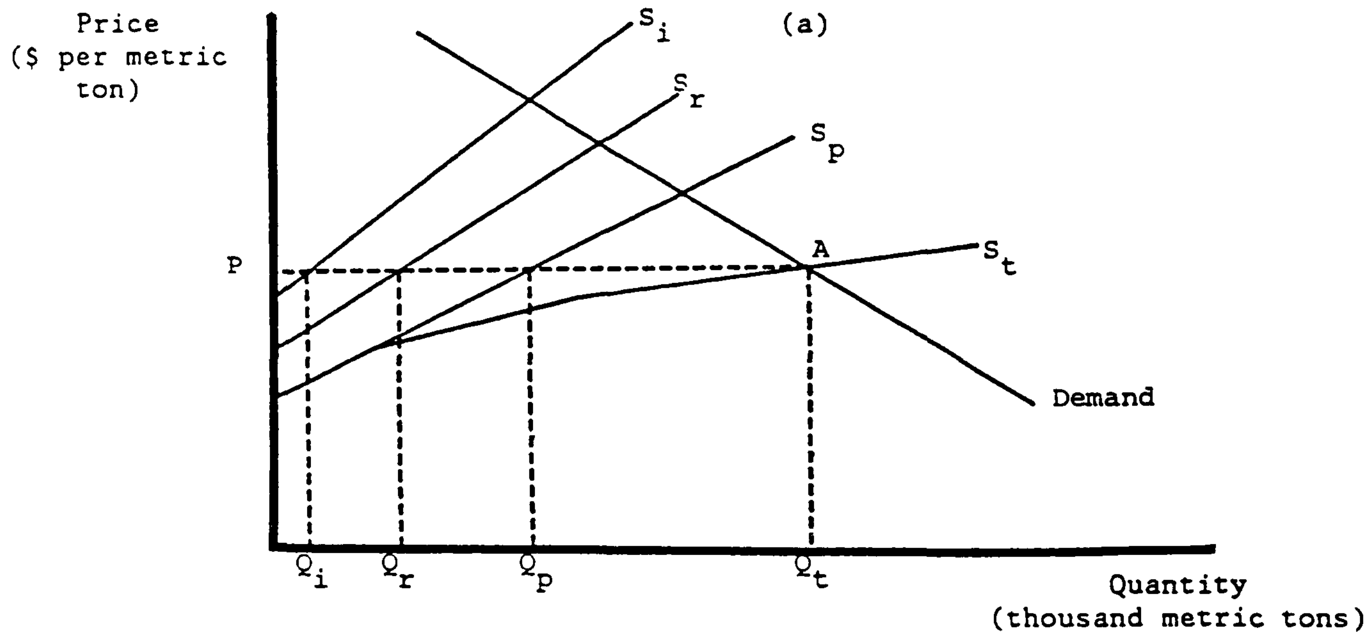
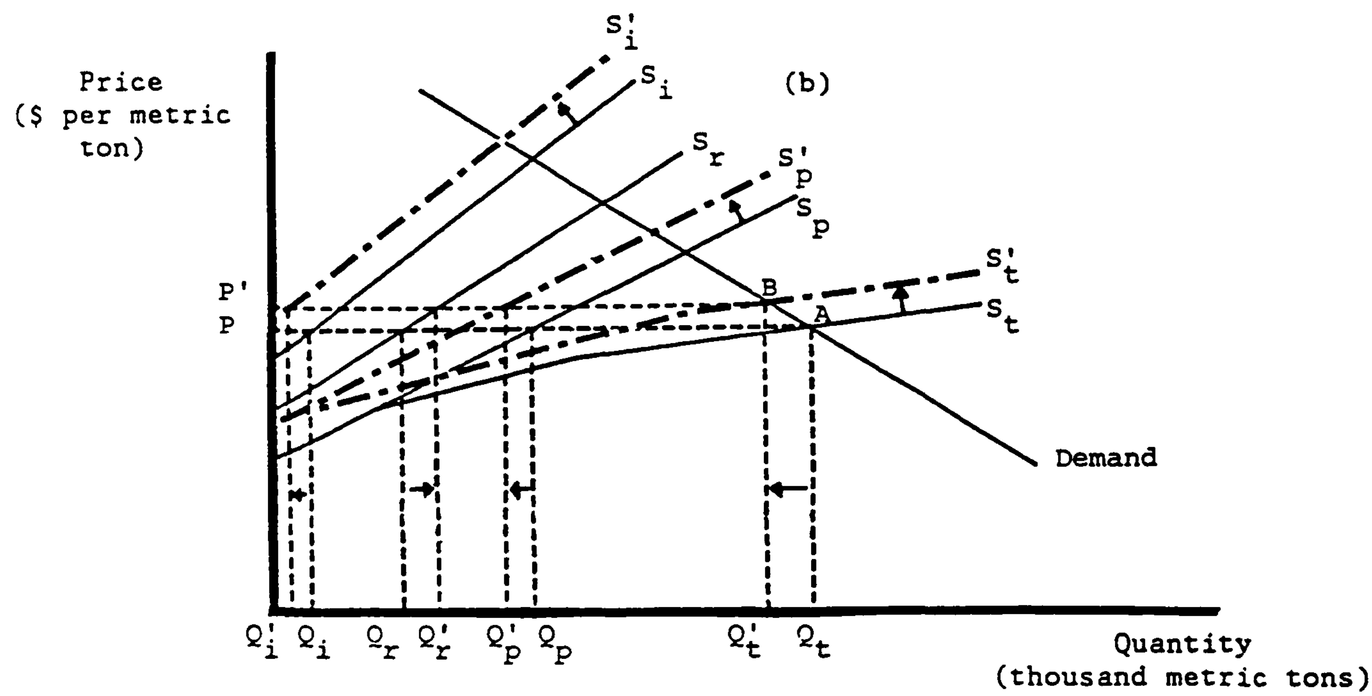


EXHIBIT 3-3

IMPOSITION OF A CERCLA TAX ON U.S. PRIMARY AND IMPORTED COPPER ONLY, EXEMPTING U.S. RECYCLED COPPER





Graph (a) in Exhibit 3-2 depicts the market for copper before the imposition of the CERCLA tax and graph (b) shows the market once the CERCLA tax is imposed. A convenient way of thinking about the tax on all forms of copper is that it decreases the net price per unit received by producers for any given quantity of the metal supplied. This corresponds to upward shifts of the supply schedules as shown in graph (b). In other words, producers will not sell the same amount, unless they receive the same net price for that amount as before. This implies that the price to consumers (P) must rise by the amount of the tax to call forth the original supply (Q_t).[11]

The shift of the supply schedules upward due to the tax now causes a new intersection of total supply and demand at B. At this new intersection, the price of copper is higher than it was at A, and the quantity demanded is lower. The supply of copper from imported sources, U.S. recycled production, and U.S. primary production have each decreased; the amount of the drop for each depends on the slopes of the different supplies and on the slope of the demand curve. When the curves are relatively "flat," signifying that producers and consumers are very sensitive to price changes, the total quantity decreases the most.

Exhibit 3-3 shows the effects of the imposition of a CERCLA tax on U.S. primary and imported copper only, exempting U.S. recycled copper. Generally, the effects are similar. However, a crucial difference is that the supply schedule for U.S. recycled copper does not shift upward because, unlike the other suppliers, the suppliers of recycled copper are not taxed. As a result, producers of recycled copper tend to supplant the others as suppliers of the market.

3.3 SELECTION OF RECYCLED METALS FOR ANALYSIS

A preliminary step in the economic analysis of taxing recycled metals under CERCLA is selecting the recycled metals to be examined. This section explains how the metals were selected on the basis of three criteria:

- Taxable Quantity. The estimated taxable quantity of the metal (domestic primary production plus imports) must equal or exceed 1,000 short tons.

- Price. The current CERCLA tax rate for metals as a fraction of the price of the metal must be at least 0.25 percent.

- Toxicity. The metal, a significant proportion of the compounds containing the metal, or a large volume of wastes from processing the metal, must be toxic.

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[11] A common simplifying assumption is to assume full pass-through of a tax. In practice, however, the pass-through effects of an excise tax vary according to underlying supply and demand conditions in specific industries.

A metal must meet all three criteria to be selected for analysis. Three recycled metals meet these criteria: copper, lead, and zinc.

3.3.1 Taxable Quantity

Twenty-two non-precious metals[12] that are recycled in the United States have been identified.[13] (See Exhibit 3-4.) One criterion to determine which of the 22 metals should be examined in this study is the amount of the metal that would be subject to the tax. This criterion is based on the argument that if the quantity of metal to be taxed is very low, the administrative costs to the government of collecting the tax may exceed the tax revenues.

The cutoff point selected was 1,000 short tons per year of domestic primary production plus U.S. imports. EPA used a similar cutoff criterion in its study of how the Superfund tax system should apply to the metal smelting and refining industry.[14] This criterion suggested by EPA was reasonable, and therefore, this report adopts a similar approach in determining which recycled metals to examine.

The cutoff point is measured in terms of domestic primary production plus all imported metal. Domestically recycled metal is not included in the calculations because it would be exempt from the CERCLA tax that will be hypothetically imposed on the metals selected. Implicit in the use of this

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[12]Precious metals, because of their high value, are extensively recycled. Exemption from a small tax would not have any observable effect on recycled output. Accordingly, precious metals are not considered here.

[13]The effects of exempting recycled metals that are not currently recycled is not investigated in this report. Although a tax exemption for recycled metals might create incentives to recycle metals that are not currently recycled, analyzing the significance of such incentives would involve technological matters that are likely to be specific to each metal. Thus, it would be difficult to select currently non-recycled metals to examine and the analysis would properly be at least as technological as it would be economic in nature. This list of 22 recycled metals does not include compounds of recycled metals that are not themselves recycled (e.g., zinc sulfate, lead oxide), nor metals that are produced only by primary production and/or as a byproduct of the production of other metals. In addition, antimonial lead is considered as a type of lead.

[14]U.S. Environmental Protection Agency, "Superfund Fee System as It Affects the Metal and Recycling Industry," February 21, 1980. The study used a cutoff of 1,000 tons annual usage for two reasons: annual usage of less than 1,000 tons of a metal would be unlikely to create a significant national hazard; and the revenues from substances used in quantities less than 1,000 tons annually would not sufficiently exceed administrative costs to merit fee collection.

EXHIBIT 3-4

ESTIMATED TAXABLE TONNAGE OF RECYCLED METALS IN 1982
(Short Tons)

Aluminum	4,577,000		Mercury	1,318	
Antimony	25,669	a/	Molybdenum	1,994	f/
Beryllium	150	b/	Nickel	174,743	
Cadmium	3,650		Selenium	650	
Chromium	29,230	c/	Tantalum	36	g/
Cobalt	6,435		Tin	34,655	
Columbium	5	d/	Titanium	16,954	
Copper	1,636,916		Tungsten	5,566	h/
Iron and Steel	135,600,000	e/	Vanadium	3	i/
Lead	680,119		Zinc	753,973	
Magnesium	104,000		Zirconium	276	j/

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a/ Includes antimonial lead.

b/ U.S. demand for beryllium. There is no significant recycling.

c/ Includes U.S. produced exothermic chromium additives and other miscellaneous chromium alloys, and imported alloys, waste, and scrap.

d/ Imports only. Production data were withheld.

e/ Includes production and imports of pig iron, and production and imports of steel and cast iron.

f/ Includes 1,921 tons of U.S. produced metal powder, 34 tons of imported unwrought metal (powder), and 39 tons of imported wrought metal.

g/ Imports only. Production data were not available.

h/ Tungsten content of tungsten concentrate.

i/ Imports only. Production data were withheld; however, production is assumed to be less than 1,000 tons because of the very small and specialized use of the metal.

j/ Imports only. Production data were withheld; however, production is assumed to exceed 1,000 tons because exports may have been as high as 878 tons (exports are reported to include zirconium metal, alloys, and scraps).

Source: Bureau of Mines, U.S. Department of the Interior, Mineral Commodity Summaries 1984 (Washington, D.C.: GPO, 1984).

cutoff point is the assumption that the recycling exemption would apply only to domestic recycled metals and not to imports of recycled metals. Such an assumption is reasonable for two reasons. First, if a fundamental purpose of a tax exemption is to reduce U.S. reliance on imported metal, then imports, whether from recycled metal or primary production, should be taxed. Otherwise, the purpose of the tax exemption would be undermined. Second, data on foreign recycling of metals are difficult to find.

As displayed in Exhibit 3-4, the cutoff point eliminates four recycled metals from further consideration: beryllium, selenium, tantallum, and vanadium.

3.3.2 CERCLA Tax as a Percentage of Metal Price

Exhibit 3-5 shows the size of the current or assumed CERCLA tax[15] in relation to the prices of the 22 recycled non-precious metals. Because of the high prices of most of these metals, the tax tends to be very small in comparison to the price. Only two of the 22 metals face a tax that is greater than one percent of price and only four have a tax that is greater than 0.5 percent of price.

For those metals for which the tax/price ratio is relatively small, less than 0.25 percent, an exemption for recycling the metal is not likely to have a noticeable effect on recycled output. This hypothesis is supported by various studies indicating that the responsiveness of the supply and demand of recycled metals to price changes is rather low.[16] For example, in 1979, the U.S. Department of the Treasury concluded that even removing the sizable tax subsidies given to copper and iron ore mining -- estimated to range from eight to 12 percent of the value of output -- would not "markedly increase" the amount of recycling of scrap copper and iron.[17]

Another reason for selecting a tax/price ratio cutoff of 0.25 percent, is that under any lower cutoff, the measurable impact of the tax could be

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[15]The tax rates used in deriving hypothetical tax/price ratios for untaxed metals are based on the principles employed by Congress in determining the current CERCLA tax rates. Specifically, a tax rate of $4.45 per short ton for elemental metals is assumed.

[16]ICF Incorporated, Recycling the Materials in Municipal Solid Waste: Estimates of the Elasticities of Secondary Material Substitution and Supply, January 31, 1979; Gordon H. Geiger, "Government Regulations and Their Effect on Metallic Resource Recovery," Resources and Conservation, Vol. 9, 1982, pp. 29-43; and Elizabeth S. Bonezar, John E. Tilton, An Economic Analysis of the Determinants of Metal Recycling in the United States: A Case Study of Secondary Copper (Pennsylvania State University: Pennsylvania, 1975).

[17]Office of Tax Analysis, U.S. Department of the Treasury, Federal Tax Policy and Recycling of Solid Waste Materials, February, 1979.

EXHIBIT 3-5

TAX AS A PERCENTAGE OF THE METAL'S PRICE

	Tax Rate ($) Short Ton	Price per Short Ton ($) on 7/29/83	Tax as a Percent of Price
Aluminum	4.45 c/	1,520	0.29
Antimony	4.45 b/	3,160	0.14
Beryllium a/	4.45 c/	5,500 d/	0.002
Cadmium	4.45 b/	2,300	0.19
Chromium	4.45 b/	8,200	0.05
Cobalt	4.45 b/	25,000	0.02
Columbium	4.45 c/	12,570 d/	0.04
Copper	4.45 c/	1,560	0.28
Iron	4.45 c/	205 d/	2.17
Lead	4.45 c/	380	1.17
Magnesium	4.45 c/	2,580	0.17
Mercury	4.45 b/	10,263 e/	0.04
Molybdenum	4.45 c/	27,000	0.02
Nickel	4.45 b/	6,900	0.06
Selenium a/	4.45 c/	26,000	0.02
Steel	4.45 c/	484 d/	0.92
Tantallum a/	4.45 c/	412,000	0.0001
Tin	4.45 c/	13,149	0.03
Titanium	4.45 c/	1,530 d/	0.03
Tungsten	4.45 c/	29,400 d/	0.02
Vanadium a/	4.45 c/	29,000 d/	0.02
Zinc	4.45 c/	760	0.58
Zirconium	4.45 c/	187,500	0.002

a/ Does not satisfy production cutoff criterion.

b/ Current CERCLA tax rate.

c/ Assumed tax rate; not taxed under CERCLA.

d/ Average 1981 price.

e/ Average 1982 price.

Sources: Chemical Marketing Reporter, August 1, 1983; Bureau of Mines, U.S. Department of the Interior, Minerals Yearbook, Volume 1, Metals and Minerals, 1982, and Mineral Industry Surveys, December 30, 1982.

rendered insignificant by the more dramatic movements of normal market forces. For example, the tax on mercury is only 0.04 percent of its price. In the 40-day period from May 30 to July 22, 1983, the standard deviation in the daily cash price of mercury equaled four percent of its average price. Accordingly, the standard deviation in price during this brief period was more than 100 times larger than the amount of the tax.[18]

As displayed in Exhibit 3-5, only five recycled metals satisfy the tax/price cutoff criterion: aluminum, copper, iron and steel, lead, and zinc.

3.3.3 Toxicity

Some recycled metals may be produced in large volumes at relatively low prices and yet not cause environmental problems significant enough to justify the imposition of a tax on the metal itself. An EPA study[19] of the applicability of a Superfund tax to the metal industry used a set of five toxicity criteria to select the metals that should be taxed:

(1) The raw material is hazardous in some form (e.g., raw material, intermediate, or final product);

(2) The raw material is hazardous if spilled;

(3) Hazardous waste is generated in the production of the raw material, its intermediates, or final products;

(4) Some form of the raw material is capable of increasing the hazard potential of other substances; and

(5) The raw material is produced in large amounts.

A metal had to satisfy three of the five criteria to be considered eligible for Superfund taxation. Three of the five metals that satisfied the taxable quantity and tax/price ratio criteria also satisfied at least three of the toxicity criteria: copper, lead, and zinc. Each of these metals was determined to satisfy the first, second, third, and fifth criteria.[20] Based on that judgment, these three metals were selected for analysis of the economic impact of taxing recycled metals.

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[18] Mercury was selected because its daily cash price is reported in the Wall Street Journal. Nickel, which is the only other recycled metal with daily price quotations in the Wall Street Journal, recorded no price changes during this period.

[19] U.S. Environmental Protection Agency, "Superfund Fee System as It Affects the Metal and Recycling Industry," February 21, 1980.

[20] Ibid., p. 3-4, Table 1.

4. ECONOMIC IMPACT OF TAXING COPPER, WITH AND WITHOUT AN EXEMPTION FOR RECYCLED COPPER

This chapter applies the economic framework described in Chapter 3 to the copper industry. To place the results of the economic analysis in perspective, Section 4.1 first presents a brief profile of the U.S. copper industry, identifying its important structural and performance characteristics. Section 4.2 then provides the data used as inputs to the economic framework. Section 4.3 presents estimates of the effects of a CERCLA tax on copper supply and prices and of the impact of a tax exemption for recycled copper. Tax rates roughly equivalent to 0.3 percent, two percent, and three percent of price are analyzed.

4.1 PROFILE OF THE COPPER INDUSTRY

Copper is used in a wide range of industries due to its combination of high electrical and thermal conductivity, chemical stability, and workability, and is a designated strategic material for its military and industrial applications. The copper industry has experienced severe difficulties in recent years caused by: (1) depressed prices for its products due to the recession; (2) increasing costs of environmental regulations; (3) competition from foreign government-subsidized or controlled sources of supply; and (4) declining intensity of copper use as key consuming industries shift to substitutes such as fiber optics and plastics. In this section, we shall briefly review demand for and supply of copper, the structure of the copper industry, and recent trends in copper prices and industrial performance to provide a background to the analysis of the effects of a CERCLA tax on copper contained in Section 4.3.

4.1.1 Copper Demand

Exhibit 4-1 shows the evolution of demand in the major copper-consuming sectors and price trends for the 1978-1982 period. Consumption of refined copper increased about 15 percent between 1982 and 1983, and is expected to increase slightly again in 1984, according to the U.S. Industrial Outlook 1984. Even with these increases, total consumption will remain below the 1978-1982 average. The decline in demand for copper between 1978 and 1982 was due primarily to the recession which severely affected the durable goods, automotive, and construction sectors. In addition, there has been a recent pattern of substitution for copper combined with a lack of new markets. According to the U.S. Industrial Outlook 1984:

> For the past decade, the intensity of copper use, when measured in tons per dollar of output of the consuming industry, has been declining in about 70 percent of the copper-using sectors. These long-term declines result from substitution, miniaturization, and automotive downsizing.

Further significant substitution for copper is likely to occur in the important telecommunications market between now and 1988. Total copper demand is, therefore, projected by the U.S. Bureau of Mines to increase at only about two percent per year until 1990.

Exhibit 4-1 shows that U.S. producer copper prices reflected depressed demand for the products in 1981-82. In 1983, prices recovered somewhat, to $1,720 per metric ton, but have since fallen rapidly to $1,346 per metric ton by June 1984 largely due to increased imports.[1] In the long term, prices of $1,874 to $2,205 per metric ton may be necessary to keep many U.S. copper facilities in operation.

4.1.2 Copper Reserves and Output

Exhibit 4-2 shows the world copper reserve base for 1982 as reported by the U.S. Bureau of Mines. In the U.S., five states -- Arizona, Utah, New Mexico, Montana, and Michigan -- account for 90 percent of all reserves. The recent recession has had a severe impact on employment in small copper-mining communities in these states.

Copper supply in the U.S. is composed of primary production, secondary (scrap) production, and imports. Primary output involves a sequence of four processes: mining, milling, smelting, and refining. The basic raw material for secondary copper processing is copper and copper-based alloy scrap. Copper-based scrap can be either new scrap, a by-product of fabricating operations, or old scrap from copper-containing goods and equipment, such as automobiles.

Exhibit 4-3 shows trends in U.S. copper supply for 1978-1982. All components of supply except imports of raw ore and industry stocks fell between 1981 and 1982. Imports of refined ore rose dramatically in 1983, from 357,000 tons to 528,000 tons leading to calls for trade restrictions. On June 14, 1984, the U.S. International Trade Commission (ITC) ruled that U.S. producers are being seriously injured by the high level of imports and should receive protection. On September 6, 1984, however, the Reagan administration rejected the ITC's recommendation to impose quotas or higher tariffs on copper imports, citing the likely adverse effects this would have on employment and U.S. exports of copper fabricated products. Continued low domestic output levels caused by foreign competition and low prices could lead to permanent closure of some U.S. mines and cancellation of plans for new domestic production capacity.

4.1.3 U.S. Industry Performance and Outlook

U.S. primary copper production is dominated by a small number of companies engaged in all stages of primary production. The six largest mining companies produced over 80 percent of all copper ore mined in the U.S. in 1981. Three companies -- ASARCO, Kennecott Copper Company, and Phelps Dodge Copper Company -- operated 79 percent of total primary copper smelting capacity in the U.S. in the same year.

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[1] Wall Street Journal, May 14, 1984, June 18, 1984, p. 2.

EXHIBIT 4-1

U.S. CONSUMPTION AND PRICES OF COPPER, 1978-1982

U.S. Consumption (Thousand metric tons)	1978	1979	1980	1981	1982
Electrical	1,284	1,318	1,194	1,223	1,039
Construction	472	487	423	449	322
Machinery	273	292	271	293	187
Transportation	198	195	152	174	100
Ordinance	24	18	27	25	25
Other	118	122	109	114	88
Total	2,369	2,432	2,176	2,278	1,761
U.S. Producer Price ($/metric ton)	1,451	2,033	2,233	1,856	1,605

Sources: U.S. Bureau of Mines, Mineral Commodity Profiles, 1983: Copper; and U.S. Department of Commerce, U.S. Industrial Outlook 1984, Chapter 19, "Nonferrous Metals."

EXHIBIT 4-2

WORLD COPPER RESERVES, 1982

Country	Reserve Base (Million Metric Tons)	Percent of World Total
Chile	97	19
United States	90	18
U.S.S.R.	34	7
Zambia	34	7
Peru	32	6
Canada	32	6
Zaire	30	6
Other	161	31
World Total	510	100

Source: U.S. Bureau of Mines, 1983 Mineral Commodity Profiles: Copper.

EXHIBIT 4-3

U.S. COPPER SUPPLY, 1978-82
(Thousand Metric Tons)

	1978	1979	1980	1981	1982
Refined Production:					
Domestic Mines	1,327	1,412	1,122	1,430	1,065
Old Scrap	254	275	340	334	298
Imports of Ore, etc.	122	104	89	114	162
Imports of Refined	403	204	427	331	258
Old Scrap Unrefined	247	329	274	264	220
Industry Stocks	522	414	232	294	465
Total U.S. Supply	2,875	2,738	2,484	2,767	2,468

Source: U.S. Bureau of Mines, 1983 Mineral Commodity Profiles: Copper.

Low prices, foreign competition, and environmental protection costs have severely damaged the domestic industry recently. In 1982, 60 percent of the copper workforce in Arizona, which produces 67 percent of the nation's copper, was laid off, and about 90 percent of the copper workforce nationwide suffered some period of layoff. U.S. producers sustained combined losses of over $360 million in 1983, when aggressive sales by foreign producers led to major increases in imports. On June 17, 1984, Kennecott Corporation announced that it would cut operations by two-thirds at its Utah copper division, and lay off about 2,000 employees out of a total workforce of 4,400. Kennecott blamed low copper prices caused by oversupply as foreign producers have responded to declines in copper prices by increasing their output in an effort to maintain foreign exchange earnings.[2] ASARCO, also citing depressed copper prices, environmental regulations and shortages of copper concentrates, announced in mid-1984 that it would close its Tacoma, Washington copper smelter by the end of June 1985.[3]

Thus, the outlook for the domestic copper industry is for slow recovery from recession hampered by foreign competition, environmental costs, and continued substitution by copper consumers.

4.2 DATA INPUTS

This section presents the data used as inputs to the copper model. The data include: (1) the annual amount of copper produced in the U.S. (primary, old scrap, and new scrap); (2) the annual amount of U.S. copper imports and exports; (3) the price of copper; (4) various demand and supply elasticity coefficients; and (5) the hypothetical CERCLA tax rates. These values -- for 1982, the most recent year for which comprehensive data were available -- and their sources are presented in Exhibit 4-4.

4.3 FINDINGS AND SENSITIVITY ANALYSIS

In this section we present estimates of: (1) the effects of a CERCLA tax (roughly equivalent to current rates) on copper supply and prices; (2) the impact of a tax exemption for recycled (old scrap) copper; and (3) sensitivity analyses for taxes roughly equivalent to two and three percent of price. These estimates were generated by the economic framework described in Section 3.2. The data input values shown in Exhibit 4-4 were used to develop the base case scenario, and then the elasticities of demand and supply were varied to test the sensitivity of the results to various assumptions about the copper market.

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[2] Wall Street Journal, June 18, 1984, p. 2.

[3] The Bureau of National Affairs, Inc., "Tacoma ASARCO Copper Smelter to Close in June 1985, Company Board Announces," Environmental Reporter (July 6, 1984), pp. 388-389.

EXHIBIT 4-4

DATA INPUTS FOR ANALYSIS OF CERCLA TAX ON COPPER

Input	Value	Source	Comments
Long-run own-price elasticity of demand for copper	-0.73	Based on estimates in Franklin M. Fisher, Paul H. Cootner, and Martin N. Baily, "An Econometric Model of the World Copper Industry," The Bell Journal of Economics and Management Science (A.T.&T.: New York, 1972), Vol. 3, No. 2, p. 587.	The Fisher study is based on an econometric model of the world copper industry, fitted to 1948-1968 data. The model is disaggregated to incorporate different supply and demand equations for each of the major producing and consuming countries. This demand elasticity estimate falls between those of three other studies using data for similar time periods: Arthur D. Little, Inc. estimated -0.64, D. McNicol estimated -0.77, and Charles River Associates, Inc. estimated -2.88; see Raymond F. Mikesell, The World Copper Industry (Johns Hopkins University Press: Baltimore, 1972), Vol. 3, No. 2, p. 155. Because these studies show considerable variance in demand elasticity estimates, which Mikesell attributes to different estimation techniques, the importance of this parameter is tested under sensitivity analysis. In addition, because 15 years have elapsed since the time of the data used in the studies, sensitivity analysis is required as the coefficient may have changed with changes in the underlying structure of the demand schedule. For example, because of technological progress in the uses of aluminum, the major substitute for copper, the coefficient is probably more elastic now than during the estimation period.
Long-run Price Elasticity of Supply for U.S. Recycled (Old Scrap) Copper	0.315	Fisher, p. 582.	This supply elasticity estimate falls between those of two other studies using data for similar time periods: Elizabeth S. Bonczar estimated 0.26 and Charles River Associates, Inc. estimated 0.47. See Elizabeth S. Bonczar, An Economic Analysis of the Determinants of Metal Recycling in the United States: A Case Study of Secondary Copper (Pennsylvania State University: Pennsylvania, 1975), for U.S. Bureau of Mines, PB-245 832, p. 70, and Charles River Associates, Inc., Economic Analysis of the Copper Industry (C.R.A.: Cambridge, 1970), prepared for G.S.A., GS-00-DS-(P)-85005, p. 310.

EXHIBIT 4-4 (Continued)

DATA INPUTS FOR ANALYSIS OF CERCLA TAX ON COPPER

Input	Value	Source	Comments
Long-run Price Elasticity of Supply for U.S. Primary Copper	1.02	Based on Fisher, p. 577.	
Long-run Price Elasticity of Supply for Imported Copper	3.27	Based on Fisher, p. 595.	
U.S. Produced Primary (metric tons)	1,227,061	U.S. Bureau of Mines, "Copper," Mineral Commodity Profiles, 1983.	This includes primary copper refined from domestic mines and from imports of ore, blister, etc. This 1982 quantity is the lowest among those reported for the years 1972-1982. However, it is not expected to increase substantially.
U.S. Produced Old Scrap (metric tons)	331,000	U.S. Bureau of Mines, "Copper," Mineral Commodity Profiles 1983.	This quantity includes refined and unrefined old scrap. The quantity is fairly representative of the quantities of old scrap produced in the ten years prior to 1982.
U.S. Produced New Scrap (metric tons)	137,000	U.S. Bureau of Mines, "Copper," Mineral Commodity Profiles 1984.	This quantity presents new scrap from fabricating operations.
Net Imports (metric tons)	227,000	U.S. Bureau of Mines, Mineral Commodity Summaries 1984.	This is net imports, i.e., gross imports minus exports. Gross imports were 258,000 metric tons and exports were 31,000 metric tons in 1982. Net imports are used in the analysis because the slope of the change in imports over the change in price, which was obtained from the Fisher, Cootner, and Baily report, and used in the analysis, also pertained to net imports.
Apparent U.S. Consumption of Copper Metal (metric tons)	1,922,061		Sum of U.S. produced primary, old scrap, new scrap, and net imports.
Price of Copper Metal (per metric ton)	$1,605	U.S. Bureau of Mines, Mineral Commodity Summaries 1984.	
CERCLA Tax Rate (per metric ton)	$4.91		Calculated based on existing CERCLA tax rates of $4.91 per metric ton on elemental metals.

The following three sections contain the results of the base case scenario and of several other scenarios chosen to illustrate the widest possible range of effects. Section 4.3.1 addresses the effects on supply, prices, and revenues of a $4.91 per metric ton tax on copper. Section 4.3.2 focuses on the changes in supply, prices, and revenues if recycled (old scrap) copper is exempted from the CERCLA tax on U.S.-produced primary and imported copper. Section 4.3.3 presents the effects on supply, prices, and revenues of higher tax rates on copper -- two percent of price (the maximum tax rate considered by Congress at the time of CERCLA's passage), and three percent of price.

4.3.1 Effects of a CERCLA Tax on Copper

Exhibit 4-5 summarizes the effects of a CERCLA tax on the price, domestic output, and U.S. imports of copper, and on the tax revenues raised. The base case scenario in Exhibit 4-5 incorporates the data presented in Section 4.2. In the other cases, the elasticities of demand and supply have been changed to test the sensitivity of the results in the base case.

In case A, the price elasticity of demand for copper, which is an estimated -0.73 in the base case, has been multiplied by a factor of ten, thus increasing the elasticity. Imposition of a CERCLA tax tends to raise prices faced by consumers. The intent here is to determine the effect of the tax if consumers are much more sensitive to price increases than we have assumed in the base case scenario.

In case B, the price elasticity of supply of imports, which is an estimated 3.03 in the base case, has been reduced to zero. The intent here is to determine what would happen if foreign producers do not reduce their supply after the tax is imposed. Imposition of a CERCLA tax normally would cause both consumers to reduce the quantity demanded and producers to reduce the quantity supplied, because the price paid by consumers rises and the net price received by producers falls (because they have to pay the tax). If, however, foreign producers maintain their supply in the face of lower net prices (even though it would seem they would be better off marketing their copper elsewhere), net-of-tax prices would fall even further, and domestic producers would be forced to cut their output by a greater amount than if all (both domestic and foreign) suppliers reduced their shipments. This condition may reflect to a certain extent the current situation in the U.S. copper market, as foreign producers have increased their shipments to the U.S. despite low prices, which has served to weaken prices further, and to force U.S. producers to cut their output and workforce. Case C is a composite of cases A and B, as copper demand is ten times more elastic than in the base case, and import supply is completely inelastic.

Exhibit 4-5 shows that the effects of a CERCLA tax of $4.91 per metric ton (a tax rate comparable to the current CERCLA tax on other elemental metals) on copper output would be minimal in all cases, never exceeding one percent of the 1982 level of output. In the base case, primary output falls only one-tenth of one percent. The market price increases by an amount equal to roughly 70 percent of the tax, meaning that producers absorb about 30 percent

EXHIBIT 4-5

EFFECTS OF A CERCLA TAX ON COPPER a/

Tax Rate: $4.91 per metric ton   Market Price: $1,605 per metric ton

Case	Estimated Change from 1982 Level: Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-1,104	-0.09	-92	-0.03	-652	-0.29	3.50	0.22	8.8
Case A: Elasticity of Demand Increased Tenfold	-3,079	-0.25	-256	-0.08	-1,819	-0.80	0.98	0.06	8.7
Case B: Import Supply Elasticity Equal to Zero	-1,475	-0.12	-122	-0.04	0	0.0	3.03	0.19	8.8
Case C: Cases A and B Together	-3,312	-0.27	-275	-0.08	0	0.0	0.68	0.04	8.7

a/ Assumes a tax on recycled (old scrap) copper.

Source: ICF Incorporated.

of the costs of the tax, or $1.41 per metric ton, and reduce supply accordingly. As shown in Exhibit 4-6 revenue losses in the base case stemming from both reduced output and lower net prices received by producers would total $3.5 million for primary production, $600,000 for old scrap, and $1.4 million for U.S. imports. All of these losses represent less than one percent of the value of 1982 supply from each source.

EXHIBIT 4-6

REVENUE LOSSES DUE TO CERCLA TAX ON COPPER
(Thousand $)

Case	Primary	Change in Old Scrap a/	Imports
Base Case	-3,501	-614	-1,366
Case A	-9,757	-1,711	-3,806
Case B	-4,677	-820	-428
Case C	-10,493	-1,840	-960

a/ Assumes a tax on recycled copper.

Source: ICF Incorporated.

In case A, the market price increases only $0.98 per metric ton, producers absorb most of the tax in the case of greater consumer sensitivity to price changes. The decrease in supply and revenue from each source is nearly three times as great as in the base case.

The results from case B demonstrate that demand elasticity is more important than import supply conditions in determining the effects of the tax. The declines in primary output and in old scrap supply are only slightly greater than in the base case. Decreases in revenue are also more moderate.

In case C, primary output and revenues decline by the greatest amount, and the market price only increases $0.68, as the combination of high demand elasticity and constant supply of imports forces suppliers to absorb most of the $4.91 per metric ton tax. Revenue losses of domestic old scrap producers are not significantly greater than in case A, however.

Overall, the impact of a CERCLA tax of $4.91 per metric ton on copper is slight, with output and sales falling by less than one percent for primary or secondary producers or foreign suppliers. Total revenue losses in the base case would be $4.1 million for domestic primary and secondary producers. In case C, total revenue losses would be $12.3 million for domestic primary and secondary producers, or one-half of one percent of total revenues for all suppliers in 1982. CERCLA tax revenues raised would amount to approximately $8.7 million to $8.8 million under each case.[4]

4.3.2 Effects of a Tax Exemption for Recycled Copper

Exhibit 4-7 summarizes the economic effects of exempting recycled (old scrap) copper from a CERCLA tax on domestic primary production and imported copper. The exhibit was derived as follows: (1) calculate the effects of a CERCLA tax on primary, recycled, and imported forms of copper; (2) calculate the effects of a CERCLA tax on primary and imported forms of copper only; and (3) calculate the difference between the two scenarios. The exhibit is presented in this way to isolate the effects of the possible tax exemption for recycled copper. To meaningfully assess the effects of a tax exemption, there must be a presumption that a tax exists in the first place. Thus, the baseline for the analysis is the situation in which all forms of copper -- primary, recycled, and imported -- are taxed.

The base case and case A shown in Exhibit 4-7 are the same as in Exhibit 4-6 -- that is, the elasticity of demand has been increased tenfold in case A. In case B, the price elasticity of supply from each source has been increased by a factor of ten (instead of setting the price elasticity of import supply equal to zero, as in the previous section). The intent here is to determine if a substantial increase in the sensitivity of suppliers to changes in prices would greatly increase the net effects of the tax in terms of affecting the quantities supplied. In case C, only the elasticity of supply of old scrap has been increased by a factor of ten.

As shown in Exhibit 4-7, an exemption for old scrap supply of copper would have minimal effects if copper were subject to a CERCLA tax. Only in case B does the decline in primary copper production exceed one-tenth of one percent of all primary copper output. Old scrap output is most affected by the exemption, increasing by nearly one percent in case B. U.S. imports and the market price of copper are not significantly influenced by the exemption in any of the sensitivity cases. CERCLA tax revenues raised would amount to approximately $7.1 million under each of the cases; or about $1.6 million less than the situation in which all forms of copper -- primary, old scrap, and imported -- are taxed.

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[4]This is significantly larger than the current CERCLA tax revenues from three copper compounds -- cupric sulfate, cupric oxide, and cuprous oxide. For the 30-month period from April 1981 to September 1983, total tax collections for these three compounds amounted to $233,000. This is equivalent to $93,000 in tax revenues on an annual basis.

EXHIBIT 4-7

EFFECTS OF A TAX EXEMPTION FOR RECYCLED COPPER

Tax Rate: $4.91 per metric ton   Market Price: $1,605 per metric ton

Case	Estimated Change a/								
	Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-136	-0.01	308	0.09	-80	-0.03	-0.17	-0.01	-1.6
Case A: Elasticity of Demand Increased Tenfold	-38	Negl.	316	0.06	-22	-0.01	-0.05	-0.003	-1.6
Case B: Increased Elasticity of Supply from All Sources	-1,832	-0.15	3,038	0.92	-1,082	-0.47	-0.23	-0.01	-1.6
Case C: Increased Elasticity of Supply from Old Scrap Only	-1,030	-0.08	2,334	0.71	-609	-0.27	-1.32	-0.08	-1.6

a/ These changes were calculated from a baseline in which all forms of copper -- primary, recycled, and imported -- are taxed (see text).

Source: ICF Incorporated.

4.3.3 Effects of Higher Tax Rates

Exhibits 4-8 and 4-9 show the effects of higher tax rates -- two percent of price and three percent of price, respectively -- on copper supply, prices, and tax revenues. As shown in Exhibit 4-8, a CERCLA tax of $32.10 per metric ton on copper would result in a decline in primary copper production of 0.6 percent, a fall in old scrap output of 0.2 percent, and a drop in U.S. import of 1.9 percent in the base case. The price of copper would increase by 1.4 percent in the base case. Annual CERCLA tax revenues raised would amount to approximately $56.9 million in the base case. If supply and/or demand are more price-sensitive than assumed in the base case, price effects would be less and quantity effects would be greater, suggesting that more of the tax would be absorbed by the copper industry.

As shown in Exhibit 4-9, a CERCLA tax of $48.15 per metric ton on copper would result in larger declines in output in the base case: a fall in primary copper production of 0.9 percent; a drop in old scrap output of 0.3 percent; and a decline in U.S. imports of 2.8 percent. The price of copper would increase by 2.1 percent in the base case. Annual CERCLA tax revenues raised would amount to approximately $85.1 million in the base case. Again, if supply and/or demand are more price-sensitive than assumed in the base case, the domestic industry would assume more of the burden.

EXHIBIT 4-8

EFFECTS OF A TWO-PERCENT CERCLA TAX ON COPPER a/

Tax Rate: $32.10 per metric ton Market Price: $1,605 per metric ton

	Estimated Change from 1982 Level								
	Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
Case	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-7,217	-0.59	-599	-0.18	-4,264	-1.88	22.88	1.43	56.9
Case A: Elasticity of Demand Increased Tenfold	-20,131	-1.64	-1,671	-0.50	-11,894	-5.24	6.38	0.40	56.2
Case B: Import Supply Elasticity Equal to Zero	-9,644	-0.79	-800	-0.24	0	0	19.78	1.23	57.0
Case C: Cases A and B Together	-21,650	-1.76	-1,797	-0.54	0	0	4.44	0.28	56.5

a/ Assumes a tax on recycled (old scrap) copper.

Source: ICF Incorporated.

EXHIBIT 4-9

EFFECTS OF A THREE-PERCENT CERCLA TAX ON COPPER a/

Tax Rate: $48.15 per metric ton   Market Price: $1,605 per metric ton

	Estimated Change from 1982 Level								
	Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
Case	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-10,826	-0.88	-899	-0.27	-6,397	-2.82	34.32	2.14	85.1
Case A: Elasticity of Demand Increased Tenfold	-30,196	-2.46	-2,506	-0.76	-17,842	-7.86	9.57	0.60	83.5
Case B: Import Supply Elasticity Equal to Zero	-14,466	-1.18	-1,201	-0.36	0	0	29.67	1.85	85.2
Case C: Cases A and B Together	-32,475	-2.65	-2,695	-0.81	0	0	6.66	0.42	84.2

a/ Assumes a tax on recycled (old scrap) copper.

Source: ICF Incorporated.

5. ECONOMIC IMPACT OF TAXING LEAD, WITH AND WITHOUT AN EXEMPTION FOR RECYCLED LEAD

This chapter applies the economic framework described in Chapter 3 to the lead industry. To place the results of the economic analysis in perspective, Section 5.1 first presents a brief profile of the U.S. lead industry, identifying its important structural and performance characteristics. Section 5.2 then provides the data used as inputs to the economic framework. Section 5.3 presents estimates of the effects of a CERCLA tax on lead supply and prices and of the impact of a tax exemption for recycled lead.

5.1 PROFILE OF THE LEAD INDUSTRY

Lead is widely used in industry as a metal, as an alloy with other elements, and as a chemical compound. It is valued for its extremely high corrosion resistance, its resistance to wear, and other qualities. Lead is considered to be a strategic and critical material, principally because of its use in storage batteries, the metal-working industry, and ammunition. The domestic lead industry and the recycled lead industry in particular have suffered in recent years from shrinking markets, low prices, and increasingly stringent environmental regulations. The U.S. remains, however, the world's largest producer and consumer of lead.

This profile of the lead industry addresses the factors affecting the demand for and the supply of lead in the U.S., the structure of the lead industry, the current market situation for lead, and the outlook for the industry in future years. The profile provides background to the analysis of the effects of a CERCLA tax on lead presented in Section 5.3.

5.1.1 U.S. Demand for Lead

Exhibit 5-1 displays U.S. consumption by end-use over the period 1978 to 1982. Storage batteries accounted for approximately 65 percent of all lead consumed in the U.S. in 1982. The next two largest markets are anti-knock additives in gasoline (11 percent) and pigments (five percent).

During the period 1978 to 1982, overall lead consumption declined approximately 25 percent. Consumption declined in every end-use market except for cable coverings, casting metals, and sheet metal. The fall in demand for lead was due primarily to the recession in the automotive and construction industries, substitution of plastics for lead in some applications, and continuing concern about lead's toxicity, which has cut into lead use in gasoline and paints. Demand remained weak in 1983, increasing less than one percent. The U.S. Industrial Outlook 1984 forecast a moderate recovery in 1984.

EXHIBIT 5-1

U.S. CONSUMPTION AND PRICES OF LEAD, 1978 TO 1982

U.S. Consumption (Thousand metric tons)	1978	1979	1980	1981	1982
Ammunition	55.8	53.2	48.7	49.5	44.2
Bearing Metal	9.5	9.6	7.8	6.9	6.1
Brass and Bronze	16.5	18.7	14.0	13.3	11.4
Cable Covering	13.9	16.4	13.4	12.1	15.2
Caulking Lead	9.9	8.0	5.7	5.5	4.1
Casting Metals	3.6	22.7	19.0	18.6	25.1
Pipes, Traps and Other Extruded Products	10.5	7.2	8.6	8.8	8.7
Sheet Lead	12.6	20.4	20.0	19.4	15.2
Solder	68.4	54.3	41.4	29.7	28.5
Storage Battery Oxides, Grids, and Post, etc.	879.3	814.3	645.4	770.2	704.3
Pigments	91.6	90.8	78.4	80.2	60.9
Chemicals: Petroleum Refining	178.3	186.9	127.9	111.4	119.2
Other	82.8	55.6	40.4	41.6	32.6
Total[1]	1,432.7	1,358.3	1,070.3	1,167.1	1,075.4
U.S. Producer Price ($/metric ton)	741.8	1,160.5	936.1	805.3	563.1

[1]Components may not add to totals shown because of rounding.

Sources: U.S. Bureau of Mines, Minerals Yearbook 1981 and Mineral Industry Surveys, October 1983.

Substitutes for lead exist for some of its applications and are under development for others. Specifically, several alternatives may eventually replace lead-acid batteries, including fuel cells and metal-alkali combinations such as zinc-bromine, zinc chloride, nickel-iron, aluminum-air, and lithium-metal salts. Substitutes in other key markets include plastics and asbestos-cement in piping, plastics and various metals in construction applications, titanium and zinc in pigments, and polyethylene and metallic-organic combinations in cable coverings. Lead's long-term prospects are, however, more affected by environmental restrictions on its use and on the trend to less lead per battery than by substitution with other products.

Lead prices reflect the depressed conditions in lead markets, with average producer prices in 1982 lower than they were in 1978. Prices continued to fall in 1983 to an average of $462.97 per metric ton (U.S. Industrial Outlook 1984).

5.1.2 U.S. Supply of Lead

The U.S. is the largest producer of lead at all stages (i.e., mined ore, smelter output, and primary and secondary refined metal) and, with a reserve base of 25 million metric tons, has over 27 percent of the total world reserve base (see Exhibit 5-2). Ninety percent of the domestic reserve base is located in Missouri, Alaska, and Idaho. In 1980, U.S. smelters accounted for 24 percent of world output.

Exhibit 5-3 presents the sources of lead metal supply in the U.S. from 1978 to 1982. Over 90 percent of lead metal used in the U.S. is produced domestically. Secondary production accounted for over 50 percent of U.S. production during this time period. In 1983, however, primary production exceeded secondary production for the first time in ten years, as the price of the raw materials used in secondary production (scrap) did not fall proportionately to the fall in the price of primary lead, resulting in raw materials for secondary production which were often too expensive to reprocess at a profit.

Primary production's share of the market increased from 38 percent in 1978 to 47 percent in 1982, while secondary production's share of the market increased slightly from 51 percent in 1978 to 52 percent in 1982. Import market share dropped from 11 percent in 1978 to only one percent in 1982. In the period from 1978 to 1982, imports averaged three percent of the market.

5.1.3 Industry Performance and Outlook

The lead industry consists of mines, smelters, and refiners. There are approximately 40 mines in 18 states but 12 mines account for 99 percent of all mined ore. Eight of these 12 mines are in southeastern Missouri (the largest is owned jointly by AMAX Lead and Homestake Lead; four others are owned by St. Joe Lead), producing 91 percent of the total.

There are 5 lead smelters in the U.S. Three of these smelters are located in Missouri (owned by St. Joe Lead, AMAX-Homestead, and Asarco) and are also

EXHIBIT 5-2

WORLD LEAD RESERVES, 1981
(Million metric tons)

Country	Reserve Base	Reserve Base as a Percentage of World Total
United States	25.0	17.2
Missouri, Alaska, & Idaho	22.5	15.5
Other	2.5	1.7
Australia	23.0	15.9
Canada	22.0	15.2
USSR	19.0	13.1
Other	56.0	38.6
World Total	145.0	100.0

Source: U.S. Bureau of Mines, Mineral Commodity Profiles, 1983: Lead.

EXHIBIT 5-3

U.S. LEAD METAL SUPPLY, 1978-1982
(Thousand metric tons)

	1978 Quantity	1979 Quantity	1980 Quantity	1981 Quantity	1982 Quantity
Primary Production	568	578	548	498	517
Secondary Production	769	801	676	641	571
Net Imports	160	106	(151) a/	45	13
Total U.S. Supply	1,497	1,485	1,073	1,184	1,101

a/The U.S. was a net exporter of lead in 1980.

Source: U.S. Bureau of Mines, Mineral Commodity Summaries, 1983 and 1984.

refineries. The two other smelters are owned by Asarco and are located in Montana and Texas. There is also a refinery owned by Asarco in Nebraska.

The secondary lead industry consists of 40 major operating plants which produce over 95 percent of all recycled lead metal. New scrap is generated during the fabrication of lead by the approximately 450 firms that consume lead.

Industry's performance improved somewhat in 1983 from the slump of the prior years. Lead consumption and prices were still very weak, with prices kept down due to high stocks and low demand. Increased zinc output, of which lead is a byproduct, contributed to the oversupply. The primary lead industry experienced a slight growth of three percent, but the secondary industry output fell 11 percent, causing a net decrease in production of five percent.

The lead industry has also been facing pressures from environmental regulations. According to the U.S. Department of Commerce, pollution control costs currently represent about 30 percent of industry's total capital expenditures.[1] OSHA's blood-level medical removal protection standard for lead affects smelter refineries and battery plants. The Clean Water Act regulates toxic waste discharge which affects secondary smelter-refineries, battery plants, and foundries handling lead alloys. The Clean Air Act regulates fugitive particulate lead and sulfur dioxide emissions from lead smelters and refineries, and the lead content in gasoline. In addition, the production of lead oxide is currently taxed under CERCLA.

According to the U.S. Industrial Outlook 1984 the prospects for the lead industry in 1984 appear to be for a moderate recovery. A slight increase in consumption is predicted because of the increase in overall economic activity and in the demand for new and replacement automobile batteries. Demand for tetraethyl lead will continue to fall because of its decreasing share of the gasoline market.

The long-term prospects for lead up to 1988, according to the U.S. Department of Commerce, depend heavily on the cost of environmental regulations and on the development of new markets. The U.S. Industrial Outlook 1984 predicts that lead consumption will increase by about three percent per year, as will lead consumption in batteries. Tetraethyl lead consumption will continue decreasing at a rate of about 8 to 10 percent per year, and may decrease even faster if EPA's proposed new rules requiring a 91 percent cut in the amount of lead in gasoline by 1986 go into effect. It is likely that secondary lead will increase its share of the lead market.

5.2 DATA INPUTS

This section presents the data used as inputs to the lead model. The data include: (1) the annual amount of lead produced in the U.S. (primary, old

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[1]Bureau of Industrial Economics, U.S. Department of Commerce, U.S. Industrial Outlook 1984, p. 19-5.

scrap, and new scrap); (2) the annual amount of U.S. lead imports and exports; (3) the price of lead; (4) various demand and supply elasticity coefficients; and (5) the hypothetical CERCLA tax rate. These values -- for 1982, the most recent year for which comprehensive data were available -- and their sources are presented in Exhibit 5-4.[2]

5.3 FINDINGS AND SENSITIVITY ANALYSIS

In this section we present estimates of: (1) the effects of a CERCLA tax (roughly equivalent to current rates) on lead supply and prices; (2) the impact of a tax exemption for recycled lead; and (3) sensitivity analyses for taxes roughly equivalent to two and three percent of price. These estimates were generated by the economic framework described in Section 3.2. In the case of lead, it was necessary to incorporate the effects of removing the tax on lead oxide in order to avoid double-taxation. This procedure is described in Appendix C (see the supplementary report). The data input values shown in Exhibit 5-4 were used to develop the base case scenario and then the elasticities of demand and supply were varied to test the sensitivity of the results to various assumptions about the lead market.

The following three sections contain the results of the base case scenario and of several other scenarios chosen to illustrate the widest variation in effects. Section 5.3.1 focuses on the effects of a CERCLA tax of $4.91 per metric ton on lead. Section 5.3.2 reviews the impact of a tax exemption for recycled lead in the event of a CERCLA tax on lead. Section 5.3.3 presents the effects of higher tax rates on lead -- two percent of price (the maximum tax rate considered by Congress at the time of CERCLA's passage), and three percent of price.

5.3.1 Effects of a CERCLA Tax on Lead

Exhibit 5-5 summarizes the effects of a CERCLA tax on the price, domestic output, and U.S. imports of lead, and on the tax revenues raised. The base case incorporates the data inputs presented in Section 5.2. In case A, the price elasticity of demand for lead, which is -0.33, has been multiplied by a factor of ten. In case B, the price elasticity of supply of lead imports has been reduced to zero, and case C is a composite of cases A and B. All four scenarios are the same as those used to estimated the effects of a CERCLA tax on copper.

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[2]As described in Appendix C of the supplementary report, in cases where the appropriate baseline for the economic analysis is one in which existing CERCLA taxes should not be included (for example, when lead metal is to be taxed rather than the substance downstream -- lead oxide), the model generates a hypothetical baseline of prices and quantities that would exist in the absence of the current CERCLA taxes. To generate this hypothetical baseline, additional information beyond what is shown in Exhibit 5-4 is required: the amount of lead required as input to the manufacture of lead oxide (input/output coefficient), the annual amount of lead metal consumed by the lead oxide industry, and the quantity produced and price of lead oxide.

EXHIBIT 5-4

DATA INPUTS FOR ANALYSIS OF CERCLA TAX ON LEAD METAL

Input	Value	Source	Comments
Price Elasticity of Demand for Lead	-0.3380	Kenneth T. Wise, "The Effects of OSHA Regulations on the U.S. Lead Industry: An Economic Impact and Econometric Modeling Analysis," Ph.D. Thesis, MIT Department of Economics, December 1978.	Elasticity of -0.3454 (Wise) adjusted to reflect the change associated with the removal of the lead oxide tax.
Price Elasticity of Supply of U.S. Primary Lead	0.4748	Wise.	Elasticity of 0.4791 based on Wise, adjusted to reflect the change associated with the removal of the lead oxide tax.
Price Elasticity of Supply for U.S. Recycled (Old Scrap) Lead	0.5133	Wise.	Elasticity of 0.5131 based on Wise, adjusted to reflect the change associated with the removal of the lead oxide tax.
Price Elasticity of Supply for Imported Lead	6.7809 a/	Wise.	Elasticity of 6.8163 based on the slopes and elasticities of foreign supply and demand in Wise. Elasticity then adjusted to reflect the change associated with the removal of the lead oxide tax.
U.S. Production of Primary Lead (metric tons)	517,218	U.S. Bureau of Mines, Mineral Commodity Summaries 1984.	Estimated production if tax on lead oxide were lifted. Based on actual production of 517,000 in 1982.
U.S. Production of Recycled (Old Scrap) Lead (metric tons)	571,536	U.S. Bureau of Mines, Mineral Industrial Surveys, October 1983.	Estimated production if tax on lead oxide were lifted. Based on actual production of 571,276 in 1982.
U.S. Net Imports of Lead (metric tons)	13,434	U.S. Bureau of Mines, Mineral Commodity Summaries 1984.	Estimated net imports if tax on lead oxide were lifted. Based on actual net imports of 13,000 in 1982.
Consumption of Lead (metric tons)	1,102,188	U.S. Bureau of Mines, Minerals Yearbook, 1982 preprint.	Estimated consumption if tax on lead oxide were lifted. Based on apparent consumption of 1,101,276.
Price of Lead (per metric ton)	$563.54	U.S. Bureau of Mines, Mineral Industrial Surveys, October 1983.	Estimated price if tax on lead oxide were lifted. Based on actual price of $563.54 per metric ton in 1982.
CERCLA Tax Rate (per metric ton)	$4.91		Calculated based on existing CERCLA tax rates of $4.91 per metric ton on elemental metals.

a/ It is reasonable for this elasticity to be significantly higher than the domestic supply elasticities because foreign suppliers have relatively greater ability to change their foreign export markets without much additional expense. They would probably be better off doing so because a tax in the United States would likely raise the world price, so they could get a higher net price in other countries.

EXHIBIT 5-5

EFFECTS OF A CERCLA TAX ON LEAD a/

Tax Rate: $4.91 per metric ton   Market Price: $563 per metric ton

Case	Estimated Change from 1982 Level								Annual Tax Revenues Raised Million $
	Primary Output		Old Scrap Output		Net Imports		Market Price		
	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	
Base Case	-340	-0.07	-405	-0.07	-675	-5.2	3.14	0.56	5.4
Case A: Elasticity of Demand Increased Tenfold	-1,450	-0.28	-1,731	-0.30	-2,884	-22.2	0.60	0.11	5.4
Case B: Import Supply Elasticity Equal to Zero	-642	-0.12	-767	-0.13	0	0.0	2.45	0.44	5.4
Case C: Cases A and B Together	-1,646	-0.32	-1,965	-0.34	0	0.0	0.19	0.03	5.4

a/ Assumes a tax on recycled (old scrap) lead. Also assumes that the existing CERCLA tax on lead oxide is removed.

Source: ICF Incorporated.

Exhibit 5-5 shows that, as in the case of copper, the effects of a CERCLA tax of $4.91 per metric ton on lead supply would be minimal, especially in the base case, where the decline in primary and secondary domestic output would be less than one-tenth of one percent. U.S. imports, however, would decline by a more significant share of their former level, an estimated five-percent fall in the base case. The market price of lead increases by an amount equal to two thirds of the tax in the base case, indicating that producers absorb one third of the tax, or $1.77 per metric ton. Revenue losses in the base case stemming from reduced output and lower net prices received by producers would total less than $1 million for either U.S. primary producers or old scrap producers.

In case A, where consumers are assumed to be more sensitive to price changes, the market price increases by only $0.60, producers absorb most of the tax. The decrease in supply and revenue from each source is three to four times as great as in the base case. The results from case B, as was the situation with copper, demonstrate that demand elasticity is more important than import supply conditions in determining the effects of the tax. The declines in primary and recycled output in case B, where importers do not reduce the amount supplied, are only twice as large as in the base case. In case C, primary and recycled output decline by the greatest amount, and the market price only increases by $0.19, as the combination of high demand elasticity and the inelastic supply of imports force suppliers to absorb most of the tax.

Overall, the impact of a CERCLA tax of $4.91 per metric ton on lead, as was the case with copper, appears slight, with primary and recycled output never falling by more than one-third of one percent of their 1982 levels. Foreign suppliers, however, reduce their supplies to a significantly greater extent. CERCLA tax revenues raised would amount to approximately $5.4 million under each case.[3]

5.3.2 Effects of a Tax Exemption for Recycled Lead

Exhibit 5-6 summarizes the economic effects of exempting recycled (old scrap) lead from a CERCLA tax on primary production and imported lead. The exhibit was derived as follows: (1) calculate the effects of a CERCLA tax on primary, recycled, and imported forms of lead; (2) calculate the effects of a CERCLA tax on primary and imported forms of lead only; and (3) calculate the difference between the two scenarios. The exhibit is presented in this way to isolate the effects of the possible tax exemption for recycled lead. To meaningfully assess the effects of a tax exemption, there must be a presumption that a tax exists in the first place. Thus, the baseline for the analysis is the situation in which all forms of lead -- primary, recycled, and imported -- are taxed.

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[3]This is considerably larger than the $3 million collected in the 30-month period from April 1981 to September 1983 by the current CERCLA tax on lead oxide. This amount is equivalent to $1.2 million in tax revenues on an annual basis.

EXHIBIT 5-6

EFFECTS OF A TAX EXEMPTION FOR RECYCLED LEAD

Tax Rate: $4.91 per metric ton   Market Price: $563 per metric ton

	Estimated Change a/								
	Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
Case	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-452	-0.09	2,017	0.35	-899	-7.4	-1.03	-0.18	-2.8
Case A: Elasticity of Demand Increased Tenfold	-135	-0.03	2,395	0.42	-269	-2.1	-0.31	-0.06	-2.8
Case B: Increased Elasticity of Supply from All Sources	-5,903	-1.14	18,515	3.24	-11,744	-90.3	-1.35	-0.24	-2.9
Case C: Increased Elasticity of Supply for Secondary Source Only	-1,559	-0.30	6,955	1.22	-3,866	-29.7	-3.57	-0.63	-2.8

a/ These changes were calculated from a baseline in which all forms of lead -- primary, recycled, and imported -- are taxed (see text).

Source: ICF Incorporated.

The base case and case A shown in Exhibit 5-6 are the same as in Exhibit 5-5. In case B, the price elasticity of supply from each source has been increased by a factor of ten (instead of setting the price elasticity of import supply equal to zero, as in the previous section). The intent here is to determine if a substantial increase in the sensitivity of suppliers to changes in prices would greatly increase the net effects of the tax in terms of affecting the quantities supplied. In case C, only the elasticity of supply of old scrap has been increased by a factor of ten. This is intended to see if a much larger relative price sensitivity of old scrap supply significantly alters the net impact of the exemption on these producers.

As shown in Exhibit 5-6, an exemption for old scrap lead would have minimal effect if lead were subject to a CERCLA tax. Only in case B does the decline in primary lead production exceed one percent of all primary lead output in 1982. Old scrap output is most affected (in terms of the change in the quantity produced and sold) by the exemption, increasing by three percent in case B versus only 0.35 percent in the base case. U.S. imports are significantly influenced by the exemption, falling by 7.4 percent in the base case and 90 percent in case B, where all suppliers are assumed to be very sensitive to price changes. The market price is not substantially affected by the exemption, decreasing by only 0.18 percent in the base case. CERCLA tax revenues raised would amount to approximately $2.6 million under each case, or about $2.8 million less than the situation in which all forms of lead -- primary, old scrap, and imported -- are taxed.

5.3.3 Effects of Higher Tax Rates

Exhibits 5-7 and 5-8 show the effects of higher tax rates -- two percent of price and three percent of price, respectively -- on lead supply, prices, and tax revenues. As shown in Exhibit 5-7, a CERCLA tax of $11.27 per metric ton on lead would result in a decline in primary lead production of 0.3 percent, a fall in old scrap output of 0.3 percent, and a drop in U.S. imports of 22.9 percent in the base case. The price of lead would increase by 1.5 percent in the base case. Annual CERCLA tax revenues raised would amount to approximately $12.4 million in the base case.

As shown in Exhibit 5-8, a CERCLA tax of $16.91 per metric ton on lead would result in larger declines in output in the base case: a fall in primary lead production of 0.4 percent; a drop in old scrap output of 0.5 percent; and a decline in U.S. imports of 32.7 percent. The price of lead would increase by 2.2 percent in the base case. Annual CERCLA tax revenues raised would amount to approximately $18.5 million in the base case.

Exhibits 5-8 and 5-9 also show the economic effects if supply and/or demand are more price-sensitive than assumed in the base case. If supply and/or demand are more price-sensitive, price effects are less, quantity effects are greater, and the lead industry bears a greater proportion of the tax burden.

EXHIBIT 5-7

EFFECTS OF A TWO-PERCENT CERCLA TAX ON LEAD a/

Tax Rate: $11.27 per metric ton   Market Price: $563.54 per metric ton

	Estimated Change from 1982 Level								
	Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
Case	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-1,498	-0.29	-1,787	-0.31	-2,980	-22.92	8.34	1.48	12.4
Case A: Elasticity of Demand Increased Tenfold	-4,046	-0.78	-4,829	-0.85	-8,049	-61.92	2.49	0.44	12.2
Case B: Import Supply Elasticity Equal to Zero	-2,192	-0.42	-2,616	0.046	0	0	6.74	1.20	12.4
Case C: Cases A and B Together	-4,496	-0.87	-5,366	-0.94	0	0	1.46	0.26	12.3

a/ Assumes a tax on recycled (old scrap) lead.

Source: ICF Incorporated.

EXHIBIT 5-8

EFFECTS OF A THREE-PERCENT CERCLA TAX ON LEAD a/

Tax Rate: $16.91 per metric ton   Market Price: $563.54 per metric ton

Case	Estimated Change from 1982 Level: Primary Output, Metric Tons	Primary Output, Percent	Old Scrap Output, Metric Tons	Old Scrap Output, Percent	Net Imports, Metric Tons	Net Imports, Percent	Market Price, $/Metric Ton	Market Price, Percent	Annual Tax Revenues Raised, Million $
Base Case	-2,138	-0.41	-2,552	-0.45	-4,254	-32.72	12.51	2.22	18.5
Case A: Elasticity of Demand Increased Tenfold	-5,961	-1.15	-7,115	-1.24	-11,861	-91.24	3.74	0.66	18.2
Case B: Import Supply Elasticity Equal to Zero	-3,180	-0.61	-3,795	-0.66	0	0	10.12	1.80	18.5
Case C: Cases A and B Together	-6,637	-1.28	-7,922	-1.39	0	0	2.19	0.39	18.4

a/ Assumes a tax on recycled (old scrap) lead.

Source: ICF Incorporated.

6. ECONOMIC IMPACT OF TAXING ZINC OXIDE AND OF EXEMPTING RECYCLED ZINC FROM POTENTIAL TAXATION OF ZINC

CERCLA Section 301(a)(1)(H) refers to the exemption from the CERCLA tax on zinc oxide. Section 301(a)(1)(I) refers to the effects of a possible tax exemption for recycled metals. Section 3.3 of this report identifies three metals -- copper, lead, and zinc -- as candidates for an analysis of the net effect of taxing recycled metals. As zinc and zinc oxide are closely related substances, this chapter addresses both the effects of a tax on zinc oxide and the net impact of a tax exemption for recycled zinc. To assess the impact of a tax exemption for recycled zinc, it is first necessary to estimate the effects of a tax on zinc metal itself, because a recycling exemption would be meaningless in the absence of such a tax.

Section 6.1 of this chapter presents a brief economic profile of the zinc industry with separate information provided, where possible, on zinc oxide. Data were available separately for zinc oxide production, consumption, imports, and substitutes but not for zinc oxide industry performance or prospects. Certain conclusions about zinc oxide can, however, be inferred from zinc industry data and from discussions with experts at the U.S. Bureau of Mines.

Section 6.2 presents estimates of the effects of a CERCLA tax on zinc oxide, and includes the results of a sensitivity analysis where the values of key variables in the model are altered. Tax rates roughly equivalent to current rates, two percent of price, and three percent of price are analyzed. Section 6.3 presents estimates of the impact of exempting recycled zinc from a CERCLA tax, assuming that zinc metal itself is taxed. A sensitivity analysis is also contained in Section 6.3. Both Sections 6.2 and 6.3 present a discussion of the sources and data used to develop the economic estimates.

6.1 PROFILE OF THE ZINC AND ZINC OXIDE INDUSTRIES

Zinc is the fourth most widely used industrial metal, due to its low melting point for casting, its high electrochemical activity for corrosion protection in zinc-galvanized steel, and its ability to alloy readily with copper to make brass. Zinc oxide is the most widely-used compound of zinc, due to a number of useful properties, and is also the starting point for most zinc industrial chemical compounds. Zinc is a strategic and critical metal because of its applications in construction, transportation, electrical equipment, and machinery.

The domestic zinc and zinc oxide industries have declined in the 1970's and early 1980's as imports have taken a larger share of the market for both products. Low prices, declining domestic mine production, less competitive older plants, and government environmental regulations have also contributed to the decline in primary production capacity for zinc. Although substitute materials are available for many uses of zinc and zinc oxide, both substances have maintained their position in most key markets. In this section we review demand for and supply of zinc and zinc oxide, the structure of the domestic zinc industry, trends in zinc and zinc oxide prices, and recent industrial performance by zinc producers.

6.1.1 Zinc and Zinc Oxide Demand

Exhibit 6-1 shows demand for zinc and zinc oxide in the major consuming sectors for the period 1978-1982. Zinc prices are shown for the same period. According to officials at the U.S. Bureau of Mines, zinc oxide prices generally average 3-10 cents per pound, or $66.13 - $220.5 per metric ton, higher than zinc prices. Thus the pattern of zinc oxide prices can be inferred from Exhibit 6-1.

Consumption of slab zinc recovered somewhat in 1983 from its depressed 1982 levels and prices rose by 20 percent in the first eight months of the year, according to the 1984 U.S. Industrial Outlook. The outlook for 1984 is for more modest increases in demand and prices, with slab zinc demand remaining below 1978-79 levels. The decline in demand for zinc between 1978 and 1981 was due principally to the recession in the U.S. automotive and construction industries, which consume most of the zinc used in galvanized steel and diecastings. Brass consumption, spread across many sectors, was also affected by the overall economic recession. The increase in rolled zinc consumption in 1982 was due to the introduction of zinc into pennies, which constitute a significant new market.

Zinc oxide demand also fell over the 1978-82 period, primarily because of recession-induced declines in demand for rubber and chemicals, two major markets. The 1984 U.S. Industrial Outlook projects that overall demand for zinc should grow slowly back to its 1978 level by 1988, as demands remains dependent on the automotive market.

Exhibit 6-1 shows that U.S. producer prices for slab zinc have been more stable than those for copper or lead, although real prices have undoubtedly fallen since 1979. Again, zinc oxide prices were slightly higher than zinc prices over the same time period.

Although there has been some substitutions for zinc by plastics and metals such as cast iron, bronze, and aluminum, in certain markets and a loss of markets due to automotive downsizing, technological developments in zinc alloys and increased concern with corrosion resistance have helped maintain overall zinc demand.

Substitute materials such as aluminum and magnesium provide significant competition in the chemical and pigment markets for zinc oxide. Zinconium compounds are substitutes for zinc oxide in ceramic applications. No specific information was obtained on trends in substitution for zinc oxide, although general discussions with U.S. Bureau of Mines personnel indicate that zinc oxide's position is not currently threatened to any great extent.

EXHIBIT 6-1

ZINC AND ZINC OXIDE DEMAND AND PRICES, 1978-1982

U.S. Consumption (Thousands of metric tons)	1978	1979	1980	1981	1982
A. Slab Zinc					
Galvanizing	454	453	379	369	310
Diecasting Alloys	354	314	254	209	158
Brass	141	141	99	111	73
Rolled Zinc	25	22	21	23	37
Oxides	37	35	27	19	18
Miscellaneous	39	35	31	103	101
Total Slab Zinc	1051	1001	811	835	697
Total All Zinc[1]	1442	1394	1142	1189	953
B. Zinc Oxide Shipments					
Agriculture	5	4	7	7	4
Ceramics	9	9	6	8	5
Chemicals	27	27	18	21	19
Paints	13	13	12	12	9
Photocopying	19	16	10	10	10
Rubber	97	93	62	69	63
Other	10	17	22	21	17
Total	181	178	136	149	127
C. Average U.S. Producer Price Metallic Zinc ($/metric ton)	683	822	826	982	848

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[1] Includes Slab Zinc ores and concentrates and secondary zinc.

Sources: U.S. Bureau of Mines, various publications; World Bureau of Metal Statistics, World Metal Statistics, January 1984.

6.1.2 Zinc Reserves and Output of Zinc and Zinc Oxide

Exhibit 6-2 shows the world zinc reserve base for 1982 as reported by the U.S. Bureau of Mines. The largest domestic zinc reserves are located in the Mississippi Valley and southern Appalachian regions. Major zinc-mining states include Missouri, Tennessee, and New York, which in 1981 accounted for 66 percent of zinc supply from domestic mines.

EXHIBIT 6-2

WORLD ZINC RESERVES, 1982

Country	Reserve Base (Million Metric Tons)	Percent of World Total
Canada	56	19.3
United States	53	18.3
U.S.S.R.	13	4.5
Peru	12	4.1
India	12	4.1
Republic of South Africa	14	4.8
Spain	10	3.4
Mexico	8	2.8
China	7	2.4
Other	117	40.3
TOTAL	290	100

Source: U.S. Bureau of Mines.

Zinc supply in the U.S. is composed of primary production, secondary (scrap) production, and imports. Primary production involves the following steps: mining of zinc ore, concentration of the ore, and reduction to zinc metal by electrolytic deposition or distillation. Secondary recovery of scrap zinc utilizes old diecastings, primarily from automobiles, engravers' plate, and bronze. New scrap is principally zinc-base and copper-base alloys from manufacturing operations and drosses and skimmings from galvanizing and diecasting operations.

Zinc oxide is produced either directly from zinc ore (American process) or directly from slab zinc (French process). In the U.S., about 60 percent of zinc oxide is produced by the American process. In 1982 domestic zinc-oxide was produced from 31 percent zinc ores and concentrates, 36 percent secondary materials, and 33 percent slab zinc, according to the U.S. Bureau of Mines. Zinc oxide is not recycled.

Exhibit 6-3 shows trends in U.S. zinc and zinc oxide supply for 1978-1982. Domestic output continued to decline in 1983, and total domestic production capacity fell to 320,000 tons, compared to a capacity of over one million tons in the early 1970's. U.S. production and imports of zinc were expected to increase in 1984 by a moderate amount. Declines in domestic mine and smelter production in favor of imports have been caused by obsolete plants, costly environmental standards, depressed prices, and higher mine production costs due to lower grade ore. There is some concern over long-term dependence on zinc imports and increased competitive pressures on the domestic industry, as zinc output capacity is not expected to expand between now and 1988.

EXHIBIT 6-3

U.S. ZINC AND ZINC OXIDE SUPPLY, 1978-1982
(Thousand metric tons)

	1978	1979	1980	1981	1982
A. Zinc Supply					
Domestic Mines	303	267	317	313	300
From Old Scrap	77	81	66	86	62
Imports Metal	618	527	411	603	447
Imports, ore, etc.	188	225	130	118	49
Imports, compounds	23	26	27	27	35
Industry stocks	170	137	152	126	106
Total	1379	1263	1103	1273	999
B. Zinc Oxide Supply					
Production	181	173	146	145	123
Imports	25	25	30	29	28
Total	206	198	176	174	151

Sources: U.S. Bureau of Mines, World Metal Statistics.

Imports of zinc oxide have increased throughout the 1970's and 1980's, in part due to lower U.S. tariffs than other industrialized countries.

6.1.3 Industry Structure and Performance

Several large, vertically integrated firms with mines, smelters, and refineries dominate the U.S. primary zinc industry. In 1979, six companies, AMAX, ASARCO, Bunker Hill, New Jersey Zinc, Jersey Minierè, and St. Joe Minerals, accounted for over 91 percent of U.S. primary slab zinc production and 85 percent of mine output. The secondary zinc refinery sector is less concentrated, with 12 firms owning plants.

As stated above, low prices, declining ore quality, the costs of environmental regulation, foreign competition, and aging plant have hurt the domestic zinc industry. Between 1978 and 1982, employment in zinc mining and smelting fell by some 4,300 persons, or 44 percent of the workforce.

The outlook for zinc beyond the current recovery is for the slow growth in demand to be met increasingly by imports as domestic capacity, which has fallen rapidly in the past decade, is not expected to increase. No separate forecasts were available for zinc oxide.

6.2 ZINC OXIDE

6.2.1 Data Inputs

This section presents the data used as inputs to the zinc oxide model. The data include: (1) the annual amount of zinc oxide produced in the U.S.; (2) the annual amount of U.S. imports and exports of zinc oxide; (3) the price of zinc oxide; (4) various demand and supply elasticity coefficients; and (5) the hypothetical CERCLA tax rate. These values -- for 1982, the most recent year for which comprehensive data were available -- and their sources are presented in Exhibit 6-4.

6.2.2 Findings and Sensitivity Analysis

This section presents estimates of the effects of a CERCLA tax on zinc oxide supply and prices. The estimates were generated by the economic framework described in Section 3.2. The data input values shown in Exhibit 6-4 were used to develop the base case scenario. Elasticities of demand and supply were then varied in cases A, B, and C to test the sensitivity of the results to various assumptions about the zinc oxide market.

Exhibit 6-5 shows the effects of a CERCLA tax of $3.93 per metric ton on the price, domestic output, and U.S. imports of zinc oxide, and on the tax revenues raised.[1] In the base case, effects would be minimal: domestic output declines by one-tenth of one percent, imports fall by two percent, and

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[1]The hypothetical CERCLA tax rate of $3.93 per metric ton is based on existing CERCLA tax rates of $4.91.per metric ton on elemental metals multiplied by the amount of zinc (on a molecular weight basis) required to produce zinc oxide (80 percent).

EXHIBIT 6-4

DATA INPUTS FOR ANALYSIS OF CERCLA TAX ON ZINC OXIDE

Input	Value	Source	Comments
Price Elasticity of Demand for Zinc Oxide	-1.418	S. Gupta, "An Econometric Analysis of the World Zinc Markets" <u>Empirical Economics</u>, Vol. 7, 1982, p. 227.	The Gupta study is based on an econometric model of the world zinc industry over the period 1956 to 1974. The model incorporates separate supply and demand equations for each of the major producer and consumer countries in the free market economies world.
Price Elasticity of Supply for U.S. Produced Zinc Oxide	13.720	Gupta.	Based on Gupta.
Price Elasticity of Supply for Imported Zinc Oxide	226.23 a/	Gupta.	
U.S. Production of Zinc Oxide (metric tons)	123,461	U.S. Bureau of Mines, <u>Minerals Yearbook</u>, 1982 preprint.	
U.S. Net Imports of Zinc Oxide (metric tons)	28,024	U.S. Bureau of Mines, <u>Minerals Yearbook</u>, 1982 preprint.	Net imports were calculated as imports minus exports. Imports in 1982 were 28,347 tons, and exports were 323 tons.
U.S. Apparent Consumption of Zinc Oxide (metric tons)	151,485	U.S. Bureau of Mines, <u>Minerals Yearbook</u>, 1982 preprint.	Sum of production and net imports.
Price of Zinc Oxide (per metric ton)	$981.05	U.S. Bureau of Mines, <u>Minerals Yearbook</u>, 1982 preprint.	
CERCLA Tax on Zinc Oxide (per metric ton)	$3.93		Calculated based on existing CERCLA tax rates of $4.91 per metric ton on elemental metals multiplied by the amount of zinc (on a molecular weight basis) required to produce zinc oxide (80 percent).

a/ It is reasonable for this elasticity to be significantly higher than the domestic supply elasticities because foreign suppliers have relatively greater ability to change their foreign export markets without much additional expense. They would probably be better off doing so because a tax in the United States would likely raise the world price, so they could get a higher net price in other countries.

EXHIBIT 6-5

EFFECTS OF A CERCLA TAX ON ZINC OXIDE

Tax Rate: $3.93 per metric ton   Market Price: $981 per metric ton

Case	Estimated Change from 1982 Level						Annual Tax Revenues Raised Million $
	Domestic Output		Net Imports		Market Price		
	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	
Base Case	-75	-0.14	-664	-2.4	3.84	0.39	0.6
Case A: Elasticity of Demand Increased Tenfold	-1,442	-1.17	-5,459	-19.5	3.15	0.32	0.6
Case B: Import Supply Elasticity Equal to Zero	-770	-0.62	0	0.0	3.51	0.36	0.6
Case C: Cases A and B Together	-3,944	-3.19	0	0.0	1.80	0.18	0.6

Source: ICF Incorporated.

the market price increases by 0.4 percent, or $3.84 per metric ton. This increase in the market price of zinc oxide equals 98 percent of the tax, meaning that producers absorb only two percent of the costs of the tax. As shown in Exhibit 6-6, revenue losses in the base case stemming from both reduced output and slightly lower net prices received by producers would total $184,000 for domestic suppliers and $654,000 for foreign suppliers.

EXHIBIT 6-6

ESTIMATED REVENUE LOSSES DUE TO CERCLA TAX ON ZINC OXIDE (Thousand $)

Case	Change in: U.S. Produced	Imports
Base Case	-184	-654
Case A	-1,509	-5,373
Case B	-806	-12
Case C	-4,123	-60

Source: ICF Incorporated.

In case A, the market price increases less than in the base case (0.3 percent versus 0.4 percent in the base case), as producers absorb more of the tax in response to greater consumer sensitivity to price changes. The decrease in domestic output is considerably larger than in the base case (a drop of 1.2 percent versus a fall of 0.1 percent in the base case) but is still minimal. U.S. imports are significantly influenced by the tax in case A, falling 20 percent or 5,459 metric tons.

In case B, foreign producers are assumed to maintain their supply in the face of lower demand. The results from case B demonstrate that demand elasticity is more important than import supply conditions in determining the effects of the tax. The decline in domestic output and the increase in the market price in case B are midway between the base case and case A.

In case C (a composite of cases A and B), primary output and revenues decline by the greatest amount. The market price only increases by 0.2 percent, as the combination of high demand elasticity and constant supply of imports forces suppliers to absorb most of the tax. Domestic output would decrease by approximately three percent under the assumptions of this scenario.

Tax revenues raised by a CERCLA tax of $3.93 per metric ton on zinc oxide would amount to approximately $600,000 under each of the cases. This is significantly larger than the $105,000 collected annually by the current CERCLA taxes on zinc chloride and zinc sulfate.[2]

Exhibits 6-7 and 6-8 show the effects of higher tax rates -- two percent of price and three percent of price, respectively -- on zinc oxide supply, prices, and tax revenues. As shown in Exhibit 6-7, a CERCLA tax of $19.62 per metric ton on zinc oxide would result in a decline in domestic production of 0.7 percent and a drop in U.S. imports of 11.8 percent in the base case. The price of zinc oxide would increase by 2.0 percent in the base case. Annual CERCLA tax revenues raised would amount to approximately $2.9 million in the base case.

As shown in Exhibit 6-8, a CERCLA tax of $29.43 per metric ton on zinc oxide would result in larger declines in output in the base case: a fall in domestic production of 1.1 percent and a decline in U.S. imports of 17.8 percent. The price of zinc oxide, would increase by 2.9 percent in the base case. Annual CERCLA tax revenues raised would amount to approximately $4.3 million in the base case.

Exhibits 6-7 and 6-8 also show the economic effects if supply and/or demand are more price sensitive than assumed in the base case. If supply and/or demand are more price sensitive, price effects are less, quantity effects are greater, and the zinc oxide industry bears a greater proportion of the tax burden.

6.3 ZINC

6.3.1 Data Inputs

As in Section 6.2, this section presents the data used as inputs to the zinc model. The data include: (1) the annual amount of zinc produced in the U.S. (primary, old scrap, and new scrap); (2) the annual amount of U.S. zinc imports and exports; (3) the price of zinc; (4) various demand and supply elasticity coefficients; and (5) the hypothetical CERCLA tax rate. These values -- for 1982, the most recent year for which comprehensive data were available -- and their sources are presented in Exhibit 6-9.

6.3.2 Findings and Sensitivity Analysis

This section presents estimates of the changes in zinc supply and prices if recycled (old scrap) zinc were exempt from a CERCLA tax on primary production and U.S. imports of zinc. The estimates were generated by the economic framework described in Section 3.2. The data input values shown in

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[2]Based on tax collections for the 30-month period from April 1981 to September 1983 totaling $263,000 for zinc chloride and zinc sulfate.

EXHIBIT 6-7

EFFECTS OF A TWO-PERCENT CERCLA TAX ON ZINC OXIDE

Tax Rate: $19.62 per metric ton Market Price: $981.05 per metric ton

Case	Estimated Change from 1982 Level: Primary Output: Metric Tons	Primary Output: Percent	Net Imports: Metric Tons	Net Imports: Percent	Market Price: $/Metric Ton	Market Price: Percent	Annual Tax Revenues Raised Million $
Base Case	-876	-0.71	-3,317	-11.83	19.15	1.95	2.9
Case A: Elasticity of Demand Increased Tenfold	-7,198	-5.83	-27,254	-97.25	15.73	1.60	2.3
Case B: Import Supply Elasticity Equal to Zero	-3,842	-3.11	0	0	17.55	1.79	2.9
Case C: Cases A and B Together	-19,688	-15.95	0	0	8.99	0.92	2.6

Source: ICF Incorporated.

EXHIBIT 6-8

EFFECTS OF A THREE-PERCENT CERCLA TAX ON ZINC OXIDE

Tax Rate: $29.43 per metric ton   Market Price: $981.05 per metric ton

	Estimated Change from 1982 Level						
	Primary Output		Net Imports		Market Price		Annual Tax Revenues Raised
Case	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-1,314	-1.06	-4,975	-17.75	28.72	2.93	4.3
Case A: Elasticity of Demand Increased Tenfold	-10,796	-8.74	-40,881	-145.88	23.60	2.41	2.9
Case B: Import Supply Elasticity Equal to Zero	-5,763	-4.67	0	0	26.32	2.68	4.3
Case C: Cases A and B Together	-29,532	-23.92	0	0	13.49	1.37	3.6

Source: ICF Incorporated.

EXHIBIT 6-9

DATA INPUTS FOR ANALYSIS OF TAX EXEMPTION ON RECYCLED ZINC METAL

Input	Value	Source	Comments
Price Elasticity of Demand for Zinc	-0.9807	S. Gupta, "An Econometric Analysis of the World Zinc Market," Empirical Economics, Vol. 7, 1982, p. 227.	The Gupta study is based on an econometric model of the world zinc industry over the period 1956 to 1974. The model incorporates separate supply and demand equations for each of the major producer and consumer countries in the free market economics world.
Price Elasticity of Supply for U.S. Primary Zinc	0.8540	Gupta, p. 227	
Price Elasticity of Supply for U.S. Recycled (Old Scrap) Zinc	0.6943	Gupta, p. 228	Based on Gupta.
Price Elasticity of Supply for U.S. Recycled (New Scrap) Zinc	0.2361	Gupta, p. 227	Based on Gupta.
Price Elasticity of Supply for Imported Zinc	7.7050	Gupta.	Based on the elasticities and slope of foreign supplies and demands in Gupta.
U.S. Production of Primary Zinc (metric tons)	228,176	U.S. Bureau of Mines, Minerals Yearbook, 1982 preprint.	
U.S. Production of Recycled (Old Scrap) Zinc (metric tons)	16,808	U.S. Bureau of Mines, Minerals Yearbook, 1982, preprint.	The U.S. Bureau of Mines reported only an aggregate figure for recycled zinc metal (including old and new scrap). The value for old scrap was derived by applying the calculated ratio of old scrap of all forms of zinc to total scrap of all forms of zinc.
U.S. Production of Recycled (New Scrap) Zinc (metric tons)	60,056	U.S. Bureau of Mines, Minerals Yearbook, 1982, preprint.	The U.S. Bureau of Mines reported only an aggregate figure for recycled zinc metal (including old and new scrap). The value for new scrap was derived by applying the calculated ratio of new scrap of all forms of zinc to total scrap of all forms of zinc.
U.S. Net Imports of Zinc (metric tons)	447,101	U.S. Bureau of Mines, Minerals Yearbook, 1982 preprint.	Net imports were calculated as the difference between gross imports (447,442 metric tons) and exports (341 metric tons).
U.S. Apparent Consumption of Zinc (metric tons)	752,141	U.S. Bureau of Mines, Minerals Yearbook, 1982 preprint.	Sum of production plus net imports.
Price of Zinc (per metric ton)	$848.11	U.S. Bureau of Mines, Minerals Yearbook, 1982 preprint.	
CERCLA Tax Rate (per metric ton)	$4.91		Calculated based on existing CERCLA tax rates of $4.91 per metric ton on elemental metals.

Exhibit 6-9 were used to develop the base case estimates. In cases A, B, and C, the elasticities of demand and supply were varied to test the sensitivity of the results to various assumptions about the zinc market.

Cases A, B, and C reflect the same assumptions as in cases A, B, and C of the analysis in Chapters 4 and 5 of a tax exemption far recycled copper and recycled lead. In case A, the price elasticity of demand is increased tenfold to determine the effect of a CERCLA tax if consumers are much more sensitive to price increases than assumed in the base case. In case B, the price elasticity of supply from each source is increased tenfold to determine if a substantial increase in the sensitivity of suppliers to changes in prices would greatly increase the net effects of the tax in terms of affecting the quantities supplied. In case C, only the price elasticity of supply of old scrap zinc is increased by a factor of ten.

Exhibit 6-10 summarizes the economic effects of exempting recycled (old scrap) zinc from a CERCLA tax on primary production and imported zinc. The exhibit was derived as follows: (1) calculate the effects of a CERCLA tax on primary, recycled, and imported forms of zinc; (2) calculate the effects of a CERCLA tax on primary and imported forms of zinc only; and (3) calculate the difference between the two scenarios. The exhibit is presented in this way to isolate the effects of the possible tax exemption for recycled zinc. To meaningfully assess the effects of a tax exemption, there must be a presumption that a tax exists in the first place. Thus, the baseline for the analysis is the situation in which all forms of zinc -- primary, recycled, and imported -- are taxed.

As shown in Exhibit 6-10, a tax exemption for old scrap zinc would have a negligible effect if zinc were subject to a CERCLA tax comparable to the current CERCLA tax or other elemental metals. In the base case, the declines in domestic primary output and imports are each less than one-hundredth of one percent of the 1982 level. Only in cases B and C do the drops in imports exceed one-tenth of one percent. Old scrap output is most affected by the exemption but even this result appears negligible, especially in the base case and case A. Only in cases B and C does old scrap output increase by more than 100 tons -- increasing 673 tons in case B (a four-percent increase) and 656 percent in case C (a 3.9-percent increase). The market price of zinc is not significantly influenced by the exemption in any case. CERCLA tax revenues raised would amount to approximately $3.3 million under each of the cases, or about $100,000 less than the situation in which all forms of zinc -- primary, old scrap, and imported -- are taxed.

EXHIBIT 6-10

EFFECTS OF A TAX EXEMPTION FOR RECYCLED ZINC a/

Tax Rate: $4.91 per metric ton   Market Price: $848 per metric ton

Case	Estimated Change b/								
	Primary Output		Old Scrap Output		Net Imports		Market Price		Annual Tax Revenues Raised
	Metric Tons	Percent	Metric Tons	Percent	Metric Tons	Percent	$/Metric Ton	Percent	Million $
Base Case	-3	Negl.	67	0.40	-51	-0.01	-0.02	Negl.	-0.1
Case A: Increased Elasticity of Demand	-1	Negl.	68	0.40	-19	Negl.	-0.01	Negl.	-0.1
Case B: Increased Elasticity of Supply from All Sources	-39	-0.02	673	4.00	-616	-0.14	-0.02	Negl.	-0.1
Case C: Increased Elasticity of Supply from Old Scrap Only	-32	-0.01	656	3.90	-501	-0.11	-0.14	-0.02	-0.1

a/ Assumes a CERCLA tax on U.S.-produced primary and imported zinc metal.

b/ These changes were calculated from a baseline in which all forms of zinc metal -- primary, recycled, and imported -- are taxed (see text).

Source: ICF Incorporated.

PART II: FERTILIZER FEEDSTOCKS

7. EXPENDITURE EXPERIENCE OF THE FUND WITH RESPECT TO FERTILIZER FEEDSTOCKS AND ASSOCIATED SUBSTANCES

CERCLA Section 301(a)(1)(H) requires that the impact of exemptions from taxation for certain substances be examined. The precise language of section 301(a)(1)(H) is as follows:

> [Experience with the implementation of this Act regarding] an exemption from or an increase in the substances or the amount of taxes imposed by section 4661 of the Internal Revenue Code of 1954 for copper, lead, and zinc oxide, and for feedstocks when used in the manufacture and production of fertilizers, based upon the expenditure experience of the Response Trust Fund.

Ammonia, methane used to produce ammonia, nitric acid, and sulfuric acid used for the production of fertilizers, are exempted from CERLCA taxes. The same feedstocks are taxed at levels specified in Title II of the Act when used for nonfertilizer-related uses.

Chapter 7 examines the expenditure experience of the Fund with respect to releases of fertilizer-related materials (feedstocks and final products). It explores whether Fund resources are being expended for removal/remedial actions for fertilizer-related materials. Chapter 8 examines the impact of taxing the currently exempt fertilizer feedstocks.

This chapter is organized as follows:

7.1 Production and Distribution of Fertilizers
7.2 Defining "Expenditure Experience of the Fund"
7.3 Alternative 1 - Historical and Planned Removal and Remedial Actions
7.4 Alternative 2 - Other Proxies for "Expenditure Experience of the Fund"
7.5 Summary of Findings

7.1 PRODUCTION AND DISTRIBUTION OF FERTILIZERS

The term "fertilizer" throughout this report refers to a manufactured material containing one or more of the essential primary plant nutrients -- nitrogen, phosphorous, and potassium. In this section, the production and distribution systems for each will be discussed in terms of the potential for release. Each of the three major types of fertilizers are discussed in turn.

7.1.1 Nitrogenous Fertilizers

Nitrogen, the leading nutrient in terms of tonnage used, is obtained from the atmosphere. Combining hydrogen from natural gas feedstock (primarily methane) with atmospheric nitrogen to form ammonia is the first step in making nitrogenous fertilizers. Ammonia (a CERCLA-tax exempt fertilizer feedstock), in combination with other basic fertilizer feedstocks, is used for the production of the nitrogenous fertilizers outlined in Exhibit 7-1. Eighty percent of ammonia produced in the U.S. (14.5 million tons in 1983)[1] is used to make fertilizer. The balance is used in the manufacture of explosives and polymers for fibers and fabricated plastics.[2] Exhibit 7-2 describes the use pattern of each of these nitrogenous fertilizers, and certain salient industry characteristics for each of the materials. This data indicates the likelihood that a spill occurring during transportation of the material is fertilizer-related. For example, if 80 percent of the production of a material is used as fertilizer feedstock and the industry is so highly integrated that very small quantities of the feedstock are transported over long distances, then a spill of the feedstock material occurring during transportation is unlikely to be fertilizer-related.

Exhibit 7-2 shows that ammonia is not transported in large quantities for the manufacture of the nitrogenous fertilizers listed in the Exhibit. This is because most of the nitrogenous fertilizer plants are located adjacent to the ammonia producing plants. However, ammonia is transported either for purposes of direct application or for the production of phosphatic fertilizers. Phosphatic fertilizer plants are located close to the raw material sources because transporting rock is uneconomical compared to transporting ammonia for fertilizer production.[3] Since the raw material sources for ammonia (natural gas wells) occur in different places from phosphatic fertilizer plants, ammonia has to be transported for the production of phosphatic fertilizers.

Phosphatic Fertilizers

Phosphorus comes from "phosphate rock," a calcium phosphate ore found in the U.S. in Florida, North Carolina, Tennessee, Idaho, Montana and Wyoming. Exhibit 7-3 lays out the downstream phosphate fertilizers from phosphate rock. Nearly 50 percent of the U.S. phosphate rock production, and 55 percent of its sulfuric acid are used to produce fertilizers.[4] The production of phosphoric acid is centered around the areas where phosphate rock and sulfuric acid, the major inputs into phosphoric acid, are produced. Most phosphoric acid producers produce sulfuric acid at the site, from sulfur purchased in

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[1] "Key Chemicals -- Ammonia," Chemical and Engineering News, January 30, 1984, p. 11.

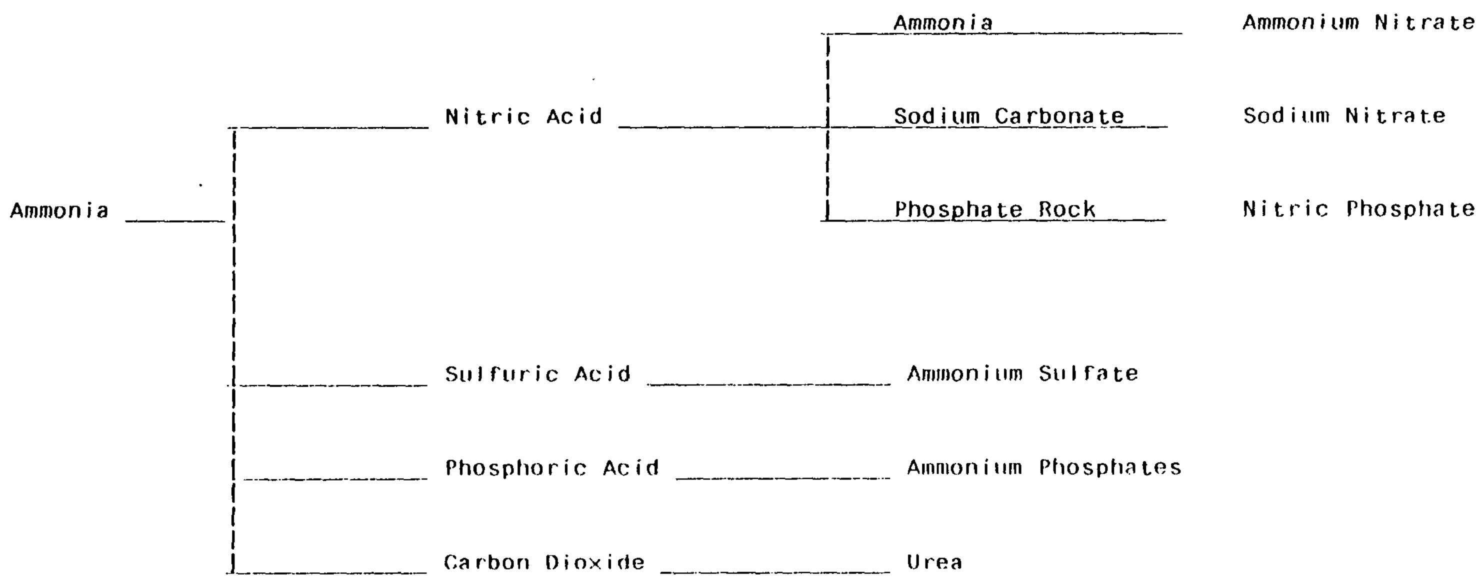
[2] Ibid.

[3] Duane A. Paul and R.L. Kilmer, "The Manufacturing and Marketing of Nitrogen Fertilizers in the United States," Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 390, p. 23.

[4] Paul and Kilmer, p. 31.

EXHIBIT 7-1

PRODUCTION OF NITROGEN FERTILIZERS



Source: The Fertilizer Handbook, The Fertilizer Institute, Washington, D.C., 1982, p. 47.

EXHIBIT 7-2

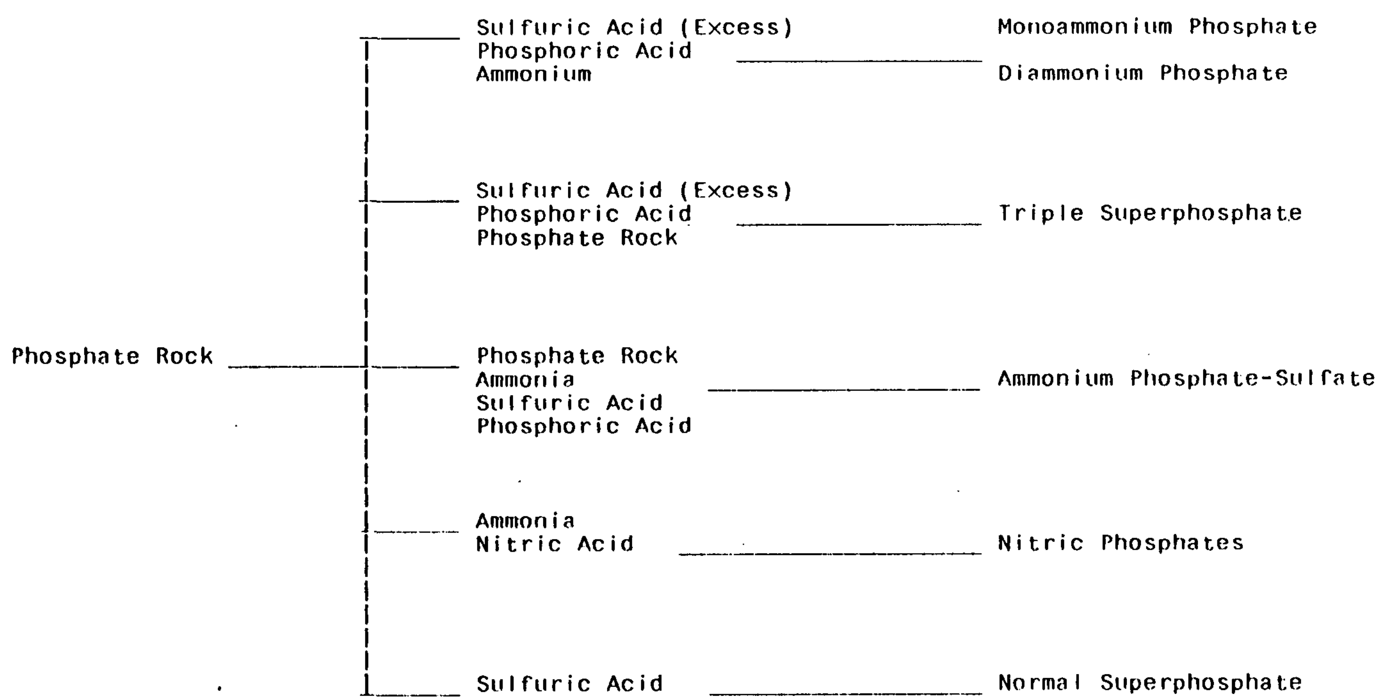
NITROGENOUS FERTILIZER FEEDSTOCKS AND MATERIALS

Feedstocks/Materials	Percent Fertilizer Related Use	Percent Non-Fertilizer Related Use	Remarks
Ammonia	80	20	Plants usually located close to natural gas sources - Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.
Ammonium Nitrate	N/A	N/A	Requires ammonia and nitric acid for production. Usually part of ammonia-nitric acid-ammonium nitrate integrated complex. It is the most used nitrogenous fertilizer.
Urea	80	20	Approximately 6 million tons produced in 1983. Other uses include animal feed and adhesives and plastics. Two thirds of all urea plants in existence are located adjacent to ammonia plants.
Ammonium Sulfate	N/A	N/A	Major source is coke ovens where sulfuric acid is used to remove ammonia evolved from coal. Small amounts are made directly from ammonia and sulfuric acid.
Nitrogen Solutions	100%	0%	Solutions of urea and ammonium nitrate.
Nitric Acid	79	21	Usually located adjacent to ammonia plants. Total industry capacity 12 million tons, 9.5 million tons of which is fertilizer related.
Sulfuric Acid	55	45	For fertilizer use, plants usually located adjacent to fertilizer production complexes.

Source: Paul and Kilmer, 1977
Chemical and Engineering News, 1984
The Fertilizer Institute, 1982.

EXHIBIT 7-3

FERTILIZER PRODUCTION FROM PHOSPHATE ROCK



Source: The Fertilizer Institute, 1982.

Louisiana and Texas.[5] Transportation of sulfuric acid for phosphoric acid manufacture, therefore, is minimized. Concentrated superphosphate and ammonium phosphate production centers are also more closely located to raw material sources than to markets. Both of these fertilizers can be manufactured at a lower delivered cost when they are located close to phosphoric acid, phosphate rock, and ammonia production centers than when located near the product markets.[6] Clearly, therefore, most of the sulfuric acid and phosphoric acid used for phosphatic fertilizers is produced and consumed at the sites where the fertilizer is manufactured. The commodities which are transported are sulfur and the phosphatic fertilizer products. The structure of the industry ensures that the transportation of acids and ammonia is minimized.

Potassium Fertilizers

Potassium, the third primary nutrient, also comes from mineral ores. The ore, called muriate, can be applied directly to the soil as potassium chloride or sulfate without extensive chemical conversion. Ninety-five percent of potash mined in the U.S. is used as fertilizer.[7] The ore is mined and beneficiated at the mine site and shipped directly to the retailer in order to minimize costs. The production of potassium fertilizers does not involve the CERCLA feedstocks of ammonia, sulfuric acid, or nitric acid, and they will not be further addressed in this analysis.

7.2 DEFINING "EXPENDITURE EXPERIENCE OF THE FUND"

As with metals, the concept of "expenditure experience of the Response Trust Fund" is subject to interpretation with respect to fertilizer feedstocks and their derivatives. However, for fertilizers, there are additional factors which complicate the specification of a well-accepted proxy for such expenditure experience:

- Fertilizers are likely to be accidentally released during the normal course of their distribution chain, thus suggesting that removal actions would occur more frequently than remedial actions.

- Fertilizer feedstocks are exempt from the tax only for use as fertilizers. Other uses of sulfuric acid, nitric acid, and ammonia are subject to the tax. Therefore, the presence of one of these three taxed feedstocks (or their derivatives) at a release where Fund expenditures

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[5] Duane A. Paul, Richard L. Kilmer, et al., "The Changing U.S. Fertilizer Industry," Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report, No. 390, p. 36.

[6] Ibid., p. 37.

[7] "Key Chemicals -- Potash," Chemical and Engineering News, July 11, 1983, p. 10.

were made is not necessarily by itself a powerful indicator of whether the Fund is being used to respond to releases of fertilizers.

The first point above suggests that removal actions are perhaps more important then remedial actions for determining whether Fund resources have been spent remedying fertilizer releases. The second point suggests that information regarding whether Fund resources have been used to respond to releases of ammonia, nitric acid, sulfuric acid, or their derivatives, must be supplemented with other information about the conditions of the release. This will allow for a better determination of whether or not Fund resources have been used to respond to fertilizer releases.

The most immediate proxy for "expenditure experience of the Fund" for fertilizers would be historical and planned removal and remedial actions. Three different data sources need to be accessed in order to determine whether historical and planned removal or remedial actions have encountered fertilizer feedstocks or their derivatives:

- Historical removal actions need to be tracked through the Removal Tracking System Data Base,

- Historical remedial actions need to be tracked through data on the six remedial actions taken thus far, and

- Planned remedial actions need to be tracked through the Records of Decision (ROD's) which exist for those sites.

Section 7.3 discusses the findings from these three sources.

Because there is some question as to whether the historical and planned removal and remedial actions represent a sufficient number of actions on which to judge the expenditure experience of the Fund, it might be necessary to define an alternative proxy for "expenditure experience of the Fund." Such a proxy would entail analyzing a larger set of potential remedial and removal actions. Such data could be developed from the following sources:

- Data on potential releases (and hence removal actions) could be obtained from the National Response Center or the regions (particularly Regions VII & VIII).

- Data on potential remedial actions could be obtained from the Hazard Ranking System Data Base.

This alternative proxy is discussed in Section 7.4. However, the reader should be aware that evidence of a release of fertilizer feedstocks or their derivatives is not by itself a good indicator that Fund resources are used, because many fertilizer releases are remedied by the responsible party. This phenomenon is accounted for in the data presented in Section 7.4.

7.3 ALTERNATIVE 1: HISTORICAL AND PLANNED REMOVAL AND REMEDIAL ACTIONS

7.3.1 Historical Removal Actions: Removal Tracking System Data Base

Removal activities constitute the emergency response portion of the Superfund program. Removal activities are short-term responses to immediate threats from accidental releases and releases from uncontrolled hazardous waste sites. They thus complement CERCLA remedial activities, which are long-term responses designed to prevent or mitigate the migration of hazardous substances into the environment on a more permanent basis. Removal actions generally cost less than $1 million and take less than six months to complete. The four major elements of the Superfund emergency response program are:

- Notification -- the methods by which EPA learns of hazardous substance releases. The primary sources of release information are notifications to the NRC or to the EPA regions;

- Monitoring -- the on-scene or off-scene supervision of private party or state removal actions by EPA On-Scene Coordinators (OSCs) and EPA-supervised contractors;

- Immediate removal actions -- Fund-financed response actions taken to prevent or mitigate acute threats to human life or health, or the environment from hazardous substance releases; and

- Planned removal actions -- Fund-financed response actions taken in an expedited fashion to prevent or mitigate significant but not time-critical threats to public health or welfare or the environment.

The Removal Tracking System, compiled by the EPA Emergency Response Division of the Office of Emergency and Remedial Response, summarizes information on all approved immediate and planned removals. The information provided includes the location of the site/spill, materials involved, threat posed, and the amount of funds requested in order to mitigate the threat. The presence of fertilizers at these removal site/spill locations would provide direct evidence that Superfund resources were used to clean up hazardous waste problems caused by fertilizers. The listing of "Materials Involved" at each site was reviewed in order to determine whether any fertilizer feedstocks or their derivatives were present. The substances searched for include: nitric acid, sulfuric acid, phosphoric acid, ammonia, ammonium nitrate, sodium nitrate, nitric phosphate, ammonium sulfate, ammonium phosphates and urea (a complete listing of substances is given in footnote 10). Of the approximately 210 approved immediate and planned removals described in the Removal Tracking System for the period from December, 1980 through the end of Fiscal Year 1983, seven included potential fertilizer feedstocks and their derivatives among the materials involved at the site/spill. Exhibit 7-4 shows the data provided in the Removal Tracking System for these sites. Additional information on each

EXHIBIT 7-4

APPROVED IMMEDIATE REMOVALS

Decided	Received	Working Days	Site/Spill Location	Materials Involved	Threat	Initial Ceiling	Comments
6/9/82	6/9/82	1	Plastifax Corp. Gulfport, Ms.	Phosphorous acid, caustic soda, sulfuric acid, paraffin and other unknown chemicals.	Fire/explosion hazard and threat of direct contact. Air, soil, groundwater and surface water contamination.	$200K	
9/3/82	9/3/82	1	Tuba City Acid Tank Coppermine, Az.	8,000 gallons of 75% sulfuric acid.	Air contamination (threat of vapor cloud) and direct contact threats.	$38K	
12/10/82	12/10/82	1	Flood Damage St. Louis, Mo.	Cyanide, nitric acid, propane gases.	Surface water contamination, threat of direct contact.	$50K/RA	
2/14/83	2/14/83	1	Abandoned Chemicals Cleveland, Oh.	Chromic acid, bromine liquid, hydrochloric acid, sulfuric acid, procaine, carbon tetrachloride, potassium cyanide, sodium azide, and propane.	Air, direct contact, and fire/explosion.	$10K	
6/8/83	6/8/83	1	Standard Chemical Co. Huntington, Ca.	Flammables; combustibles; caustics; triethylamine; nitric acid; dimethylformamide; enamel; paints and paint wastes.	Fire/explosion hazard.	$200K/RA	
6/16/83	6/16/83	1	Gebhart Fertilizer Co. Latham, Il.	Pesticides; fertilizers, oxidizers; petroleum products.	Direct contact; fire/explosion hazard.	$122K/RA	On 5/19/83, the RA verbally approved this request. However, the RA request several revisions to the 10-point document which delayed the final signing of this request at the regional level.
6/17/83	6/17/83	1	Hampton Cylinder Site Hampton, Va.	Carbon dioxide; acetylene; fluoromethane; ammonia; propane; TCE.	Direct contact, fire/explosion hazard.	$250K/RA	

site/spill which contained potential fertilizer feedstocks was obtained from the records maintained for each removal by the Emergency Response Division (ERD). These records include reports prepared by On-Scene Coordinators and technical data regarding the site/spill. Assessments about whether the substances present were used in fertilizer production are based on data about the other chemicals found at the site, and any relevant information contained in the records at ERD. This methodology yields no definite conclusions about the actual uses of the substances found at the site/spill; however, it does provide a rough indication of whether these releases (or derivatives of any of these) were fertilizer-related.

Description of Sites/Spills

Tuba City Acid Tank, Coppermine, Az.: The report on the site indicates that the sulfuric acid found was to be used in a mining reclamation project.

Plastifax Corp., Gulfport, Ms.: The Plastifax Corporation produces chlorinated paraffin and wax. The emergency involved a fire/explosion at the site. The sulfuric and phosphorous acid found at the site were probably destined for use in the company's industrial processes.

Abandoned Chemicals, Cleveland, Oh.: The chemicals involved were found inside 2 condemned buildings, formerly used to manufacture antiseptics.

Flood Damage, St. Louis, Mo.: The incident involved the removal of drummed chemicals and waste which were washed away during a flood. All of the owners of the chemicals drums were not determined. It is possible that the drums of nitric acid found were destined for fertilizer production usage.

Hampton Cylinder Site, Hampton, Va: The abandoned cylinder testing facility contained over 45 hundred improperly stored, leaking and deteriorating drums. Other materials found at the site were: nitrogen, liquid oxygen, argon, chlorine, helium, sulfur hexachloride, hydrogen fluoride, sulfur chloride and methyl bromide. The fact that many of the other materials found at the site were gases used for cylinder testing indicates that it is unlikely the ammonia found at the facility was to be used in fertilizer production.

Gebhart Fertilizer Co., Latham, Il.: The Gebhart Fertilizer Company is an abandoned fertilizer and farming chemical distributor. Solid and liquid pesticides and fertilizers existed on the site, in addition to herbicides. The On-Scene Coordinator's report on the site indicated that all of the solid fertilizer and most of the liquid fertilizer were removed from the site by a farming supply company, at no expense. The more difficult part of the cleanup involved the disposal of the solid pesticides and herbicides by landfilling.

Standard Chemical Co., Huntington, Ca.: The nitric acid found in the fire/explosion at the Standard Chemical Company was among a large number of chemicals. The materials found at the site along with the nitric acid were chemicals related to paint; it is unlikely that the nitric acid present was to be used in fertilizer production.

Of the 7 sites/spills which possibly involved fertilizer materials, the Gebhart Fertilizer Co. would seem to provide the clearest evidence that expenditures from the Fund were used to remedy hazardous waste sites/spills involving fertilizers. However, in this case, the removal of fertilizers at the site, in contrast to the disposal of the pesticides and herbicides present, was achieved easily and at little or no expense. Though the potential uses of the nitric acid found at the Flood Damage site in St. Louis, Mo. is indeterminate, nitric acid destined for use in fertilizer production would probably not be transported in drums, but in larger quantities. Furthermore, nitric acid used in fertilizer is often produced at the same location as ammonia, and thus is less likely to be transported. It can be surmised that the chemicals found at the other five sites/spills, based on the reports at ERD and the concomitant chemicals, were unlikely to be used in fertilizer production.

7.3.2 Historical Remedial Actions: The Six Remedial Actions

Under the Fund, remedial action has been taken at six waste sites as of June 1984. These sites are listed in Exhibit 7-5, along with the types of wastes found at the sites. No fertilizer material was present at the four sites for which sufficient information was available; sufficient information is not available about the two remaining sites.[8]

7.3.3 Planned Remedials: Records of Decisions (ROD's)

There have been 26 Records of Decision (RODs) by EPA for remedial actions at NPL sites; only one of those ROD's involves one of the eight sites containing possible fertilizer material, the Stringfellow Acid Pits site. The possible fertilizer materials reported at this site are nitrates and sulfate ion; there is probably no way to determine whether these wastes are actually fertilizer-related.

7.3.4 Summary of Findings

Preliminary evidence suggests that there is only weak evidence that Fund resources are used to respond to releases of fertilizer materials. Of the approximately 210 removal actions described in the Removal Tracking System for the period from December 1980 through the end of fiscal year 1983, only one removal could, with certainty, be attributed to fertilizer-related materials. The majority of fertilizer-related material at this site was removed by a farming supply company, at no expense to the Fund. Under the Fund, remedial action has been completed at six waste sites. Of these six sites, four contain no fertilizer-related materials; sufficient information is not

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[8] The two sites are Walcott Chemical Warehouse, Greenville, Mississippi and Luminous Processes, Athens, Georgia. No fertilizer producers are located in Greenville, Mississipi or Athens, Georgia, according to the National Fertilizer Development Center publication, Fertilizer Trends 1982; therefore, the conclusion might be drawn that it is unlikely that any fertilizer-related materials were found at these two sites.

EXHIBIT 7-5

SITES FOR WHICH REMEDIAL ACTION HAS BEEN COMPLETED AS OF JUNE 1984

Name of Site	Types of Wastes
Chemical Metals Industry, Baltimore, MD	Cyanide, organic solvents, acid
Walcott Chemical Warehouse, Greenville, Mississippi	Information not available -- cleaned up by owner
Luminous Processes, Athens, Georgia	Information not available
Butler Tunnel, Pittson, Pennsylvania	Trichloroethylene, cyanide, toluene, xylene, dichlorobenzene
Chemicals Minerals, Cleveland, Ohio	1,1,1-Trichloroethane, toluene, perchloroethylene, chromic acid, antimony chloride
Gratiot County Golf Course, St. Louis, Missouri	PBBs, Tris, benzene

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Sources: Superfund Hotline, CERCLA Docket, EPA Region IV.

available about the other two sites to determine whether fertilizers contributed to the problem. In the case of planned remedials, of the 26 Records of Decision (RODs) analyzed, only one pertains to a site possibly containing fertilizer materials. There is no apparent way of determining whether the wastes at these sites are fertilizer-related. All available data, therefore, indicate that at best, there is only weak evidence that Fund resources are being spent on fertilizer-related releases.

7.4 ALTERNATIVE 2 - OTHER PROXIES FOR "EXPENDITURE EXPERIENCE OF THE FUND"

7.4.1 Release Data (National Response Center, Region VII, Region VIII)

In order to determine the extent to which fertilizers and the principal fertilizer raw materials contribute to hazardous substance release problems, the spills data bases of the National Response Center and EPA Regions VII and VIII were analyzed. All of these sources have computerized data bases which could be searched for information regarding releases of particular substances. NRC data on the spills of fertilizers and principal fertilizer raw materials was obtained by ICF from OERR for 1982, 1983 and January 1-March 5, 1984. This data had been searched for anything mentioning fertilizer and also for nitrates, phosphates and ammonia.[9] The data indicates from what mode of transportation the spill came, the quantity spilled, and the spill location.

The data bases of EPA Regions VII and VIII were searched using a more complete list of substances, including ammonia, nitric acid, sulfuric acid, phosphoric acid and approximately 20 other fertilizer compounds.[10] Information retrieved from these searches included the name of the owner of the spilled substance. Certain compounds found in the search, e.g., ammonium nitrate, are definitely fertilizers. The data were also reviewed in order to eliminate compounds which were clearly not fertilizers. For example, a

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[9] In response to a request from Congressman Florio, the Office of Emergency and Remedial Response (OERR) tabulated fertilizer industry spill data based on reports to NRC. ICF used the data obtained from this search.

[10] The substances which were searched for in Region VII were: ammonia, nitric acid, sulfuric acid, phosphoric acid, phosphate, sulfur, ammonium nitrate, urea, ammonium sulfate, normal superphosphate, triple superphosphate, ammonium polyphosphate, monoammonium phosphate, diammonium phosphate, nitrophosphate, nitrogen solutions, superphosphoric acid, sodium nitrate, nitric phosphate, potash, potassium chloride, potassium sulfate, calcium sulfate, potassium nitrate and ammonium hydroxide. The Region VIII data base was searched using an abridged list of words which was thought to encompass the larger list: ammonia, nitrate, phosphate, sulfate, potash, urea and potassium.

substance such as copper ammonium acetate was ultimately excluded because it is not a fertilizer. The owners of particular raw materials also provided an indication about whether the material was to be used for fertilizer production. For example, it was determined that sulfuric acid owned by the Kennicott Copper Corporation was probably not a fertilizer feedstock. This methodology was used to arrive at a rough estimate of the number of spills involving actual fertilizer compounds and probable fertilizer feedstocks.

National Response Center

The number of releases of hazardous substances relating to fertilizer during 1982, 1983 and 1984 (until March 5, 1984) were 169, 181, and 33, respectively. Total notifications to the NRC for releases of CERCLA hazardous substances were 1,914 in 1982, 2,430 in 1983 and approximately 410 between January 1-March 5, 1984. Spills potentially involving fertilizers thus comprised 8 percent of all releases of hazardous substances between January, 1982 - March 5, 1984. Reports to the NRC are not necessarily a good proxy for the expenditure experience of the Fund because an estimated 90 percent of reported releases are responded to by responsible parties.[11]

Region VII

The Region VII reporting form included a classification category "fertilizer," which in addition to specific fertilizer compounds, was used to search the data base. Computerized records of release events in Region VII have been maintained since 1983. From January 1983 through May 1984, 1,094 non-oil spills were reported. Non-oil spills are divided into 3 groups: miscellaneous chemicals, PCBs, and other spills which could not be identified. It was determined that 112 spills involved either fertilizers or fertilizer feedstocks. Fertilizers thus comprised 10 percent of non-oil spills during 1983 and 1984. Region VII Emergency Planning and Response Branch estimated that 95 percent of all spills that were remedied were financed by the responsible party. Remaining actions were completed by state and local governmental authorities, including fire departments, public works departments, and those organizations responsible for sewer and pollution control.[12]

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[11] A publication issued by the Office of Emergency and Remedial Response, "EPA's Emergency Response Program" (April 1982), notes that "In practice, about 90 percent of all emergency cleanups and removals are handled by the responsible party -- usually the generator, transporter, or disposer of the waste. The remainder are cleaned up by an industry-governmental partnership. If government resources are called upon, a variety of local state and federal agencies may be called into action.", (p. 7).

[12] Information obtained from a telephone conversation with a representative of Region VII's Emergency Planning and Response Branch.

Region VIII

The Region VIII spill report form includes a code indicating the individual/ organization which "cleaned up" the spill. The search for fertilizer materials yielded 101 entries, from 1981 to March 15, 1984. The following results regarding the party which completed action on the spill were obtained from the data base:

Party	Number of Spills
Federal Government	0
State Government	0
Local Government	5
Responsible Party	80
None	9
Unknown	5
Other Private	1
No Information	1
	101

No spills were remedied by the federal government. It was determined that 58 out of the 101 entries were probable fertilizers or fertilizer feedstocks. The total number of non-oil reported releases from January 1981 to May 15, 1984 was 599.[13J] Probable fertilizers and associated raw materials comprised 10 percent of all reports of non-oil releases.

The fact that most reported spills are remedied by responsible parties suggests that Fund resources are unlikely to be spent in the future on removing releases of fertilizer feedstocks and their derivatives. The proportion of total spills that are fertilizer-related is difficult to accurately determine, because in many cases, the final uses of the particular feedstock or its derivative are unknown. The estimate that approximately 10 percent of all non-oil spills in Regions VII and VIII are fertilizer-related, for example, may overstate the expenditure experience of the Fund with respect to fertilizer feedstocks because (1) these regions are relatively agriculture-intensive and (2) responsible parties tend to complete actions taken to remove fertilizer releases.

7.4.2 Hazard Ranking System Data Base

The Hazard Ranking System (HRS) data base was searched for possible fertilizer materials reported at 538 National Priorities List (NPL) sites. An initial list was obtained of 31 sites where materials which could be fertilizer-related were reported. The list was screened using information from the HRS data base and EPA's Hazardous Waste Site Descriptions, and the

[13J] Includes hazardous materials and a "miscellaneous" category, which is comprised of sewage, water, and substances that could not be identified.

following types of sites were removed from the list:

- sites with on-site waste generators, such as chemical companies, known to produce no fertilizer materials;
- sites with on-site waste generators at locations where no fertilizers are produced;[14]
- landfills where the only possible fertilizer material present is methane (in such cases, the methane is probably generated by on-site reactions); and
- sites where descriptions of the wastes and their sources made it clear that fertilizer materials were not involved.

After this screening, 8 sites containing materials which could be fertilizer-related remained on the list.[15] Exhibit 7-6 shows the fertilizer-related chemicals reported at these sites and the number of times each chemical was reported.

At one of the sites where fertilizer-related materials were reported, waste is generated on-site by an unnamed company.[16] Allied Corporation produces fertilizer in the city where the waste site is located; it is therefore possible that Allied is the on-site generator and the wastes at this site are fertilizer-related. No firm determination could be made about whether this is the case. The remaining seven sites are landfills or dumps. The origin of the fertilizer-related materials reported at these sites is unclear. However, in view of the large percentage of ammonia, nitric acid, phosphoric acid, sulfuric acid, and urea used as fertilizer or for fertilizer production (see section 7.1), it seems possible that at least some of the substances reported at the seven waste sites are fertilizer materials, even given the transportation patterns sketched in Section 7.1.

As mentioned above, only eight sites, or 1.5 percent of the 538 National Priorities List sites appear to contain chemicals which may be fertilizer related. Since the origin of these chemicals has not been conclusively

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[14] J. Darwin Bridges, Fertilizer Trends 1982. (Muscle Shoals, AL: National Fertilizer Development Center, Tennessee Valley Authority, 1982).

[15] The sites are the following: Davie Landfill, Davie, Florida; G&H Landfill, Utica, Michigan; Buckeye Reclamation, St. Clairsville, Ohio; Pristine, Inc., Reading, Ohio; Stringfellow Acid Pits, Glen Avon Heights, California; Nineteenth Avenue Landfill, Phoenix, Arizona; South Point Plant, South Point, Ohio; Lee's Lane Landfill, Louisville, Kentucky.

[16] South Point Plant, South Point, Ohio.

EXHIBIT 7-6

FERTILIZER RELATED MATERIALS REPORTED AT 538 NATIONAL PRIORITIES LIST (NPL) SITES

Possible Fertilizer Material	Number of Times Reported at Sites
Ammonia	4
Ammonium (unspecified)	1
Methane	2
Nitrates	2
Nitric Acid	2
Phosphoric Acid	1
Sulfate (ion)	2
Sulfuric Acid	1
Urea	1

Source: ICF tabulation of MITRE Corporation, Hazard Ranking System (HRS) data base.

determined, the figure of eight sites would seem to be more of an upper bound for sites containing fertilizer related materials; the actual number of sites may be smaller. Given that this number is likely to be approximately one percent of the total NPL sites, it is reasonable to conclude that fertilizer-related materials are a very small problem at NPL sites.

7.4.3 Summary of Findings

Three independent spills data bases, of the National Response Center, EPA Region VII, and Region VIII were analyzed to determine the extent to which fertilizer related materials contribute to hazardous substance release problems. A maximum of 10 percent of spills in Regions VII (January 1983 to May 1984) and VIII (January 1981 to March 1984) and 8 percent over a 26 month period in the case of the NRC data base were fertilizer-related. Furthermore, the analysis showed that remedial action for most reported spills was taken by responsible parties and the federal government was rarely, if ever, involved in the clean up.

A search of the Hazard Ranking System (HRS) data base to identify fertilizer related materials at National Priorities List (NPL) sites yielded a maximum of 8 sites which could contain these materials. The fact that only 8 sites could be identified out of a total of 538 (1.5 percent), and that the evidence suggesting that these eight sites are fertilizer-related is admittedly weak, clearly indicates that fertilizer materials are likely to be responsible for only an insignificant percentage of the site clean-up costs to be borne by the federal government.

Despite the broad definition for "expenditure experience of the Fund", the evidence that Fund resources are used or likely to be used to respond to fertilizer-related releases remains weak.

7.5 CHAPTER SUMMARY

When "expenditure experience of the Fund" is defined narrowly as historical removal actions, historical remedial actions, and planned remedial actions, the evidence that Fund resources are used to respond to fertilizer-related releases is weak. Only one of 210 removal actions could be clearly related to fertilizer releases and in that case, most of the Fund resources were spent responding to pesticide-related releases. No historical or planned remedial action could clearly be attributed to fertilizer-related releases. However, it is possible that some of the materials at the Stringfellow Acid Pits site are fertilizer-related, although this cannot be determined with certainty.

When "expenditure experience of the Fund" is defined more broadly, it is possible to find evidence of fertilizer-related releases. However, it seems likely that Fund resources are not used to respond to these releases. For example, of 101 potentially fertilizer-related releases in Region VIII from January 1, 1981 to March 15, 1984, 80 were acted on by the responsible party and zero were responded to by the federal government. (The remainder were either remedied by local government, were not responded to, or it was not known whether there was a response.) Thus, even though this broader definition of expenditure experience of the Fund suggests that in agriculture intensive regions, as many as 10 percent of the spills might be fertilizer-related, there is little evidence to suggest that Fund resources are used to respond to these releases.

In summary, whether using a narrow or broad proxy for expenditure experience of the Fund with respect to fertilizer-related materials, the evidence that Fund resources are used or likely to be used to respond to fertilizer releases is less then compelling, particularly when contrasted with the clarity of the evidence on metals.

8. ECONOMIC IMPACT OF TAXING FERTILIZER FEEDSTOCKS

This chapter is organized as follows:

8.1 PROFILE OF THE FERTILIZER INDUSTRY

The fertilizer industry experienced extremely difficult years in 1982 and 1983 due to a large number of factors, including depressed prices for agricultural products caused by the recession, increased competition from fertilizer imports, and declining agricultural exports. The acreage of farmland cultivated decreased as a result of the Payment-in-Kind (PIK) program and inclement weather. The situation was exacerbated by the strong dollar and rising interest rates. This section will review the demand for and supply of fertilizers, the balance of trade in fertilizers, and the structure of the industry, in order to provide background to the analysis of the effects of a CERCLA tax on fertilizer feedstocks.

8.1.1 Fertilizer Demand

Exhibit 8-1 shows the evolution of demand for fertilizer materials. Growth in consumption of fertilizer materials continued until 1982. Total fertilizer use in the U.S., including mixed fertilizer and secondary and micronutrient materials, reached an unprecedented 54 million short tons of material during the fertilizer year 1981.[1] Primary nutrient consumption, comprising nitrogen, phosphate and potash, was 23.7 million tons in 1981. Total fertilizer consumption in the 1982 fertilizer year (July 1, 1981 to June 30, 1982) declined to 48.7 million short tons, a 10 percent decrease, and diminished by 13 percent in 1983, to 42.3 million short tons. The corresponding data for the primary nutrients, nitrogen, phosphate, and potash (Exhibit 8-1) show a 10 percent overall decrease in consumption between 1981 and 1982, and a 15 percent reduction in 1983.

Predictions about fertilizer usage in 1984 were optimistic, based on the reductions in the PIK program, and depleted grain stocks. The April 1984 issue of Inputs Outlook and Situation (USDA) predicted a 17 percent increase primary nutrient consumption in 1984, reaching 21.3 million tons. The causes of this increase, according to the article, would be the projected 36 percent increase in acres of corn planted, and an 11 percent rise in overall

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[1]Each fertilizer year extends from July 1 of the previous calendar year through June 30 of the current year. All chronological references in the text refer to the fertilizer year.

EXHIBIT 8-1

DOMESTIC CONSUMPTION OF FERTILIZER
(thousand short tons)

	1978	1979	1980	1981	1982	1983
Total Fertilizer a/	47,497	51,481	52,787	53,988	48,733	42,300
Primary Nutrient Content						
Nitrogen (N)	9,965	10,715	11,407	11,924	10,974	9,185
Phosphate (P_2O_5)	5,096	5,606	5,432	5,434	4,810	4,160
Potash (K_2O)	5,526	6,244	6,245	6,320	5,623	4,842
Total	20,587	22,565	23,084	23,678	21,407	18,187

DOMESTIC PRODUCTION OF FERTILIZER
(thousand short tons)

	1978	1979	1980	1981	1982	1983
Primary Nutrient Content						
Nitrogen (N)	10,466	11,106	12,323	13,036	11,598	9,855
Phosphate (P_2O_5)	8,245	9,432	10,012	10,471	7,818	8,043
Potash (K_2O)	2,176	2,519	2,474	2,262	1,831	1,859
Total	20,886	23,057	24,809	25,769	21,247	19,757

Note: Year ending June 30

a/ Includes primary nutrient material, mixed fertilizer, secondary and micronutrient materials.

Source: "Facts and Figures for the Chemical Industry", Chemical and Engineering News, June 11, 1984, p. 40. Data source was U.S. Department of Agriculture.

cultivated acreage.[2] Recent data confirms the optimistic predictions. Net fertilizer consumption from July 1983 to April 1984 experienced a 12 percent increase from the level in last year's season.[3] The May 1984 Fertilizer Record, published by The Fertilizer Institute, gives production data for the period from July 1983 to May 1984. Overall production of fertilizers rose 6 percent during this time period, in comparison with production levels the previous year. Prices of certain fertilizers have risen during 1984. In May 1984, the price of anhydrous ammonia was 18 percent higher than the price one year ago. Triple superphosphate prices increased 8 percent during this period, diammonium phosphate rose by 9 percent, while the price of potash rose about 3 percent (Exhibit 8-2).

Fertilizer demand is fairly inelastic, with mean elasticities of demand for nitrogenous, phosphatic and potash fertilizers estimated by one source to be -0.43, -0.38, and -0.20, respectively.[4] The tax at current levels constitutes approximately 1.0 percent of ammonia prices and less than 0.5 percent of sulfuric acid and nitric acid prices. Given the high inelasticity in demand, small changes in fertilizer prices on account of the CERCLA tax are unlikely to affect consumption significantly.

8.1.2 Fertilizer Supply

Nitrogeous Fertilizers

There are a large number of producers of nitrogenous fertilizer materials. In the case of ammonia alone, there were 87 manufacturers in the beginning of 1983.[5] Given the large number of manufacturers, it is not surprising that the fertilizer material production business has the characteristics of a commodity chemical business -- high volume, low margins. Furthermore, the cost structure of these materials is such that the major percentage of cost of production is accounted for by the price of feedstock, e.g., in the case of ammonia, by the price of natural gas. U.S. producers, therefore, do not have the margins to adjust prices so as to compete with producers who can buy their feedstock cheaply. Domestic producers face significant competition from fertilizer imports, particularly from countries such as Mexico, which have large supplies of low-cost ammonia. Shifting

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[2]U.S. Department of Agriculture, Inputs Outlook and Situation, April 1984, p. 18.

[3]"Fertilizer Movement Posts New Gains," Chemical Week, 13 June 1984, p. 24.

[4]Thomas J. Lutton and Anthony Prato, "Demand for Fertilizers Under Uncertainty," U.S. Department of Agriculture, Economic Research Service (not dated).

[5]J. Darwin Bridges, "North American Production Capacity Data," Fertilizer Trends, 1982. (Muscle Shoals, Alabama: National Fertilizer Development Center, Tennessee Valley Authority).

EXHIBIT 8-2

AVERAGE U.S. FARM PRICES PAID FOR SELECTED FERTILIZER MATERIALS, 1982 to 1984[1]
(Dollars per short ton)

Year		Anhydrous Ammonia (82%)	Triple Super-phosphate (44-46%)	Diammonium Phosphate (18-46-0%)	Potash (60%)	Mixed Fertilizer (6-24-24%)
1981:	March	243	248	287	152	221
1982:	March	255	230	267	155	219
1983:	March	237	214	249	143	205
	May	237	214	249	143	206
	October	226	205	238	128	196
	December	232	210	245	131	198
1984:	March	275	229	271	144	212
	May	280	231	271	147	217

[1]Based on a recent survey of fertilizer dealers conducted by the Statistical Reporting Service, USDA.

Source: U.S. Department of Agriculture, Inputs Outlook and Situation, April 1984).

patterns in the international trade of fertilizers is discussed in section 8.1.3.

Nitrogenous Fertilizers

Nitrogenous fertilizer production decreased greatly in 1982 and 1983. Total U.S. production of nitrogen declined 11 percent between 1981 and 1982, and fell 15 percent between 1982 and 1983 (Exhibit 8-1). Individual nitrogenous fertilizers experienced the following production decreases between 1982 and 1983: anhydrous ammonia, 22 percent; solid ammonium nitrate, 18 percent; urea, 22 percent; and nitrogen solutions, 17 percent.[6]

The production of all nitrogenous fertilizers, from July 1983 through May 1984, increased 5 percent over the previous year's level. Anhydrous ammonia production was 1.4 million tons in May 1984, constituting a 20 percent increase over May 1983.[7] Lower natural gas prices resulting from excess supply have improved the outlook in the near-term for domestic production of nitrogenous fertilizers. According to some analysts, these developments, in conjunction with greater fertilizer demand, are responsible for increased urea production. Effective operating capacity of urea was 7.584 million tons at the start of the 1984 fertilizer season, while the corresponding figure for 1983 was 6.2 million tons.[8]

Phosphatic Fertilizers

There have been large increases in the production of phosphate based fertilizers during 1984. For an eleven month period ending in May 1984, production of phosphate rock increased by 26 percent, production of wet process phosphoric acid went up by 25 percent, while diammonium phosphate production went up 21 percent. Overall production of phosphate fertilizers during the period from July 1983 through May 1984 increased 18 percent over the level of the previous year.[9]

Potassium Fertilizers

The 1983 potash production of 1.8 million nutrient tons represented a 16 percent decrease from the previous year's output. Production from July 1983

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[6] U.S. Department of Agriculture, Inputs Outlook and Situation, February 1984, p. 11.

[7] Data from two publications of The Fertilizer Institute, Fert Flash, July 10, 1984 and Fertilizer Record, May 1984.

[8] "Urea Producers Optimistic, But Cheap Offshore Gas Gives Them Cause for Concern," Chemical Marketing Reporter, 9 July 1984, p. 5.

[9] Fertilizer Record (Washington, D.C.: Fertilizer Institute, May 1984.)

through May 1984 declined further, by 18 percent.[10] Decreasing potash production is attributable to the fact that domestic potash reserves are considered to be high-cost in comparison with those of other countries.[11] Potassium based fertilizers, including potash, would not be affected by the proposed CERCLA tax.

8.1.3 Balance of Trade in Fertilizers

The three largest producers of fertilizer are Canada, the United States, and the U.S.S.R. The U.S. is a net exporter of fertilizer materials, a category comprising fertilizer derivatives of nitrogen, phosphate and potassium. The U.S. has a positive balance of trade in fertilizer materials because net exports of phosphatic fertilizers are larger than the net imports of nitrogenous and potassium fertilizers. Exhibit 8-3 shows that in 1983, the U.S. had a trade surplus valued at $915 million (10,088 thousand metric tons of fertilizer material). Preliminary data from the 1984 fertilizer year also shows a positive balance of trade in fertilizer materials. The U.S. phosphatic fertilizer industry is likely to maintain its dominance in world trade because of the domestic availability of large supplies of phosphate rock at prices which are competitive with those of foreign sources. The long-term prospects of the nitrogenous fertilizer industry are not as favorable, due to competition with countries such as Mexico which have access to low cost feedstocks. Widespread closures of ammonia plants in the United States were attributed to competition from Mexican ammonia producers, who can buy their feedstock at prices substantially less than the prices faced by their U.S. counterparts.[12] The trend of feedstock-rich countries towards establishing commodity chemical industries indicates that U.S. nitrogenous fertilizer production will probably decline over time because the U.S. does not have a feedstock cost-advantage.

Nitrogenous Fertilizers

U.S. imports of nitrogenous fertilizers continue to increase. Nitrogen imports during the 1984 fertilizer year were 3.4 million tons, an increase of 47 percent over last year. Imports of ammonia during the first eleven months (July 1, 1983 to May 1984) of the 1984 fertilizer year increased by 58 percent over the previous year, while imports of urea rose 28 percent.[13]

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[10] Ibid. See also: U.S. Department of Agriculture, Inputs Outlook and Situation, February 1984, p. 5.

[11] "Fertilizer--Getting Set for the Big Rebound," Chemical Week, 9 November 1983, p. 37.

[12] "The Ammonia Crunch--Other's Cheap Feedstocks Threaten U.S. Producers," Chemical Week, February 23, 1983, p. 35.

[13] "Fertilizers Had a Super Year," Chemical Week, 18 July 1984, p. 29.

EXHIBIT 8-3

BALANCE OF TRADE IN FERTILIZER MATERIALS
(thousand metric tons)

	1979	1980	1981	1982	1983	1984 a/
Imports						
Nitrogen	3,511	3,993	3,768	3,906	4,368	2,104
Phosphate	1,171	1,196	697	348	253	69
Potash	7,773	8,258	8,382	7,316	6,719	3,001
TOTAL	12,455	13,447	12,848	11,570	11,340	5,174
Exports						
Nitrogen	3,190	3,423	4,067	3,251	2,448	841
Phosphate	20,709	23,008	21,192	16,766	17,962	8,076
Potash	1,532	1,586	1,334	989	1,018	305
TOTAL	25,431	28,017	26,593	21,006	21,428	9,222
Balance of Trade						
Nitrogen	(321)	(570)	299	(655)	(1,920)	(1,263)
Phosphate	19,538	21,812	20,495	16,418	17,709	8,007
Potash	(6,241)	(6,672)	(7,048)	(6,327)	(5,701)	(2,696)
TOTAL	12,976	14,570	13,746	9,436	10,088	4,048
Balance of Trade (value in millions of current dollars)						
Nitrogen	$ (46)	$ (25)	$ 154	$ (105)	$ (338)	$ (198)
Phosphate	1,290	1,863	2,202	1,743	1,698	708
Potash	(330)	(399)	(590)	(587)	(445)	(194)
TOTAL	$ 914	$1,439	$1,766	$1,051	$ 915	$ 316

Note: See Appendix A

a/ Data for July-November 1983.

Source: USDA, Inputs Outlook and Situation, February 1984.
USDA, Fertilizer Outlook and Situation, December 1982.

Phosphatic Fertilizers

Export performance of phosphatic fertilizers during the 1984 fertilizer season has been strong. The Fertilizer Institute reports that during May 1984, exports of diammonium phosphate reached 704,000 tons, the highest level since July 1980. Total exports of diammonium phosphate during the period from July 1983 to May 1984 were 5 million tons, representing a 22 percent increase over last year. Concentrated superphosphate exports continue to increase, while remaining lower than 1983 levels, and phosphate rock exports have grown significantly during the 1984 fertilizer season.[14]

Potassium Fertilizers

Imports of potash have risen sharply during the 1984 fertilizer year. Imports of muriate of potash from July 1983 to May 1984 totalled 8.2 million tons, constituting an 18 percent increase over last year's level. The reasons for large potash imports are different from those explaining growing nitrogenous fertilizer imports. Domestic consumption demand is too large to be met by U.S. production. Furthermore, U.S. producers have interests in Canadian potash mines; Canadian potash accounts for a large share of U.S. imports.[15]

8.1.4 Industry Structure and Performance

In 1983, the top four firms in ammonia, ammonium nitrate and urea accounted for 31 percent, 29 percent, and 37 percent of capacity, respectively. The top eight accounted for 50 percent, 51 percent, and 63 percent of capacity. Therefore, concentration in nitrogenous fertilizers is relatively low. Concentration of phosphatic fertilizers is higher, with the top four firms in phosphate rock, ammonium phosphate and concentrated superphosphate accounting for 53 percent, 46 percent, and 64 percent of capacity respectively, and the top eight firms accounting for 75 percent, 72 percent, and 94 percent. Potash is very concentrated, with the top four firms accounting for 69 percent of capacity, and the top eight 94 percent.[16] Fertilizer producers tend to be large national multi-line chemical firms as well as regional specialists. As in other chemical lines, the larger domestic firms are currently undergoing some restructuring, away from the commodity-like fertilizer business. Kaiser, Allied, and Reichhold are three firms that have recently left the fertilizer business.[17]

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[14] Fertilizer Record (Washington, D.C.: Fertilizer Institute, May 1984).

[15] Ibid. See also, "Fertilizers Had a Super Year," Chemical Week, 18 July 1984, p. 29.

[16] ICF Calculations. All capacity data for nitrogenous, phosphatic and potash fertilizers from J. Darwin Bridges, Fertilizer Trends 1982. (Muscle Shoals, Alabama: National Fertilizer Development Center, Tennessee Valley Authority.)

[17] "Fertilizers Had a Super Year," Chemical Week, 18 July 1984, p. 31.

8.1.5 Conclusion

The fertilizer industry has rebounded in 1984, with large increases in both production and consumption of most fertilizers. The principal reason for this improvement in situation is increased planted acreage, due to reductions in the PIK program and depleted grain stocks. The outlook for the phosphatic fertilizer industry is bright; exports are expected to grow as a result of continued comparative advantage. The long-run prospects of the domestic nitrogen industry are uncertain, because of competition from countries with cheap natural gas feedstocks. Large imports of potash will in all likelihood continue in order to meet domestic demand.

8.2 IMPACT ON FERTILIZER MARKETS

This section discusses the effect of the CERCLA tax on fertilizer feedstocks on the supply and demand for fertilizers. The tax has a direct impact on the price of nitrogenous and phosphatic fertilizers because both of these fertilizer types use CERCLA taxed feedstocks. Potassium containing fertilizers (e.g., Potash) are mined and applied directly to the soil. They do not go through any expensive chemical conversion (as explained in Chapter 7), and by the very nature of their production do not use any CERCLA-taxed feedstocks. The CERCLA tax therefore has no impact on their price. Potassium fertilizers will not be discussed further in this section.

The subsections which follow empirically analyze the effect of the tax on two nitrogenous fertilizers, ammonia and urea, and one phosphatic fertilizer, diammonium phosphate. The two nitrogenous fertilizers are considered because they are the most widely used fertilizers in the United States. The analysis is indicative, not conclusive. It does not purport to be a rigorous and completely accurate account of the effects of the tax. It does, however, indicate the order of magnitude of the potential demand and supply side effects of the CERCLA tax.

8.2.1 Nitrogenous Fertilizers

Ammonia: The CERCLA tax on ammonia is $2.64 per ton. This amounts to 1% of the price of ammonia, which is $275 per ton.[18] If it is assumed that the tax is passed through completely to the consumer, the price of ammonia will go up by 1%. The impact of this price increase on the demand for ammonia can be assessed approximately by using data on mean elasticities of demand for the major plant nutrients. Mean elasticities of demand for nitrogen, phosphorous and potash have been estimated at -.43, -.38, and -.20 respectively.[19] A

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[18]USDA, Inputs Outlook and Situation, April 1984, p. 20.

[19]Thomas J. Lutton and Anthony Prato, "Demand for Fertilizers Under Certainty," USDA, Economic Research Service (not dated).

one percent ammonia price increase, using the nitrogen elasticity figure, will lead to a 0.43 percent decrease in demand for ammonia. Because both supply and demand for ammonia are inelastic, the small increase in price and the even smaller change in demand and supply will have a negligible effect on the expenditure for direct application ammonia.

Urea: The inputs for the manufacture of urea are anhydrous ammonia (.54 tons/ton of urea) and carbon dioxide (.75 tons/ton of urea).[20] Carbon dioxide is exempt from a CERCLA tax, but the tax imposed by CERCLA section 211 on anhydrous ammonia is $2.64 per ton.[21] Given the proportion of ammonia going into the production of urea, the current tax levels would increase the cost of producing urea by $1.43 per ton. In December 1982, the price of urea was $222 per ton.[22] Assuming full pass-through of the tax, the percentage increase in the price of urea would be 0.6 percent. Thus, the effect of the tax on the market for urea will be even less than the effects described above.

8.2.2 Phosphatic Fertilizers

Diammononium Phosphate (DAP): Raw material requirements for the production of 1 ton of DAP are as follows:

1.6 tons of phosphate rock;
1.3 tons of 100 percent sulfuric acid; and
0.23 tons of anhydrous ammonia.[23]

Of these three raw materials, only two are taxes under CERCLA, sulfuric acid at $0.26/ton and anhydrous ammonia at $2.64/ton. Assuming full pass through of the tax, the price of DAP will increase by $0.95/ton, or 0.4 percent, based on $271/ton price of DAP in March 1984.[24] The effect of this price increase on the demand for DAP can be ascertained by using the mean elasticity of demand for fertilizers containing phosphorus, -0.38.[25] A 0.4 percent increase in the DAP price, using the phosphorous fertilizer demand elasticity data, will lead the 0.15 percent decrease in demand. Similarly, using the mean supply elasticity of phosphorous fertilizers of 0.55, the

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[20]"Fertilizer-Getting Set for the Big Rebound," Chemical Week, November 9, 1983.

[21]Kirk and Othmer, Encyclopedia of Chemical Technology, 3rd edition, (New York: Wiley-Interscience, 1980), X, p. 53.

[22]USDA, "Agricultural Prices," Statistical Reporting Service, 1982.

[23] The Fertilizer Handbook, (Washington, D.C.: The Fertilizer Institute, 1982), p. 63.

[24]USDA, Inputs Outlook and Situation, April 1984, p. 20.

[25]Lutton and Prato, p. 12.

increase in DAP supply for a 0.4 percent DAP price increase will be 0.22 percent. The small changes in demand and supply of DAP resulting from the CERCLA-taxed DAP price will negligibly affect the market for DAP.

8.2.3 Conclusion

It is more than likely that the effect of a CERCLA tax on expenditures for fertilizers will be very small, as demonstrated in the three examples above. The relative share of fertilizers in total farm production expenditure (7.5 percent, as explained in Section 8.3) is, therefore, not likely to change on account of the CERCLA tax on fertilizer feedstocks.

8.3 IMPACT ON FARMERS

A CERCLA tax on fertilizer feedstocks could affect fertilizer prices and thus affect the major users of fertilizers, namely farmers. This section analyzes the potential impact on farmers of a tax on fertilizer feedstocks.

Section 8.3.1 briefly highlights the major factors determining fertilizer demand. Section 8.3.2 presents the regional differences in fertilizer consumption, which are significant because the demand for fertilizers varies from region to region. Section 8.3.3 gives an overview of the recent experience in fertilizer demand; depressed market conditions and acreage reduction programs have drastically reduced fertilizer demand in 1982 and 1983; the situation of the industry has improved significantly in 1984. Section 8.3.4 assesses the change in fertilizer prices relative to price changes of other farm inputs. Section 8.3.5 outlines the potential effects of a fertilizer price increase on the demand for fertilizer. Given elasticities of demand and an initial tax rate, the likely impact of a CERCLA tax on fertilizer prices and demand is estimated. Section 8.3.6 is a conclusion incorporating the findings of the previous sections.

8.3.1 Farmers Demand for Fertilizers

Fertilizers are a very important input to farming in the United States. In 1981, total farm expenditures on fertilizers were estimated at $9.9 billion.[26] Fertilizer application rates per acre -- which determine the demand for fertilizer -- are a function of relative input prices, soil quality, expected output prices, and weather.[27] Of these factors, weather is, of course, the most unpredictable. Relative input prices determine the optimal input mix. Soil quality is a major factor in determining the fertilizer application rate per acre, because moister soil requires less fertilizer to produce the same output as dryer soil. Expected output prices determine the supply of farm products and consequently affect demand for farm inputs.

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[26]USDA, "Farm Production Expenditures," Statistical Reporting Service, 1982.

[27]Lutton and Prato.

8.3.2 Regional Differences

Fertilizer consumption across the United States is by no means uniform. The U.S. is a vast country with dramatic regional differences, and the farming sector is probably more diversified across the U.S. than any other sector of the U.S. economy. The importance of regional differences is that an increase in fertilizer prices due to a CERCLA tax will affect farmers' consumption of fertilizer differently, depending on their region. Exhibit 8-4 gives a summary of relative fertilizer use in 1982 by region.

Exhibit 8-5 illustrates the major regional differences in relative factor inputs in farming. The proportion of farm expenditures on fertilizers varies from 4.3 percent of total farm expenditures in the Mountain states to 10.6 percent in the Southeast. This is due, in part, to the relatively cheap price of fertilizer in the Southeast, where a lot of fertilizer plants are located. While there is no "typical" region in terms of relative expenditures on fertilizers, in the regions which account for the major share of U.S. fertilizer consumption (Lake States, Corn Belt, Northern Plains), an average of 7.5 percent of total farm expenditures are for fertilizer. This figure is close to the national average for the last few years and is a good estimate for the U.S. The effect of the CERCLA tax on this expenditure on fertilizer is explored in section 8.3.5.

8.3.3 Recent Experience in Fertilizer Demand

In recent years, fertilizer demand has been very volatile, as federally induced acreage reduction programs such as the PIK (Payment-In-Kind), combined with decreased foreign demand for U.S. farm products, have drastically reduced the amount of acres planted in 1982 and 1983. In an initial assessment of the PIK program, USDA predicted a 12 to 15 percent decrease in fertilizer use.[28] For the year ended June 1983, fertilizer consumption in the U.S. was down 13 percent from the previous year.[29] All indications are that the PIK program was a major contributor to the dramatic decline in fertilizer demand in 1982-1983. The prospects for 1984 are much improved because the PIK program has been phased out and the surplus of corn and wheat are reduced. The decreased demand in 1982-83 induced a decrease in the price of fertilizers.[30] The next section will discuss the price relationships between fertilizers and other farm inputs.

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[28]USDA, "An Initial Assessment of the Payment-In-Kind Program," Economic Research Service, 1983.

[29]USDA, "Commercial Fertilizers, Consumption," Statistical Reporting Services, Crop Reporting Board, November 1983.

[30]"Fertilizer -- Getting Set for the Big Rebound," Chemical Week, 9 November 1983.

EXHIBIT 8-4

USE OF FERTILIZER BY REGION -- 1982 a/
(percent of U.S. total)

Region	Nitrogen	Phosphatic	Potassium
Northeast	2.9	4.9	5.0
Lake States	9.8	13.0	17.5
Corn Belt	30.6	33.3	43.3
Northern Plains	15.2	10.5	2.4
Appalachian	6.2	9.1	10.7
Southeast	6.6	7.1	11.2
Delta	4.8	3.7	6.1
Southern Plains	8.7	6.8	2.3
Mountain	6.2	5.5	0.6
Pacific	8.7	5.7	2.2

a/ USDA, Inputs Outlook and Situation, February 1984.

EXHIBIT 8-5

MAJOR FARM PRODUCTION EXPENDITURES BY REGION
PERCENTAGE OF TOTAL FARM PRODUCTION EXPENDITURES -- 1982 a/

	Livestock	Farm Service Rent	Feed	Wages	Interest	Ferti-lizers	Energy	Other	Total
Northeast	6.9	11.3	20.1	13.1	7.7	7.3	7.3	26.3	100.0
Lake States	7.9	14.0	11.8	6.9	13.3	6.9	8.1	31.1	100.0
Corn Belt	12.5	20.1	12.0	3.3	11.0	9.7	6.6	24.8	100.0
Northern Plains	18.6	16.8	11.3	3.6	11.7	5.9	8.2	23.9	100.0
Appalachian	6.1	17.7	12.2	11.1	8.7	9.9	8.0	26.3	100.0
Southeast	9.0	11.6	16.8	12.9	8.3	10.4	7.5	23.5	100.0
Delta	6.7	15.1	19.0	9.0	9.4	7.0	8.8	25.0	100.0
Southern Plains	19.9	16.1	11.1	8.5	8.5	5.9	8.0	22.0	100.0
Mountain	19.6	14.2	12.5	10.1	10.9	4.3	7.8	20.6	100.0
Pacific	3.3	17.8	14.5	20.3	10.0	4.9	6.6	22.6	100.0
U.S.	11.7	16.4	13.3	8.8	10.4	7.3	7.5	2.6	100.0

a/ Source: USDA, Statistical Reporting Service, Farm Production Expenditures, Sp Sy 5 (7-83).

8.3.4 Fertilizer Prices Relative to Other Farm Input Prices

In order to assess the impact of an increase in fertilizer prices on farmers, the relationship between the price of fertilizer relative to that of other farm inputs must be ascertained. Exhibit 8-6 shows the change in prices paid by farmers for major farm inputs. Fertilizer prices have been very stable in the last few years, and declined in 1983. The major increases were in the prices of energy, livestock, and in interest costs. In 1983, fertilizer had the lowest price increase relative to all the major farm production expenditure items. In 1982-83, fertilizer prices were low, but have risen in the 1983-84 fertilizer year (see Section 8.1.1).

The impact of a CERCLA tax on fertilizer feedstocks in a period of both increasing prices and increasing demand should be smaller than when depressed market conditions prevail, especially since prices of other farm inputs such as energy and interest show no signs of abating. It is, therefore, likely that the share of farmer's expenditures on fertilizers relative to other farm inputs will remain fairly stable.

8.3.5 Conclusion

Although fertilizers are a very important input to the farming industry, expenditures on fertilizer as a percentage of total farm production expenditures have remained fairly stable over time despite some regional differences. The relative inelasticity of demand for fertilizers is likely to minimize the impact of a tax on the quantity of fertilizer demanded.

As both fertilizer prices and demand are expected to increase in the near future, the tax effect will be even smaller than in periods of depressed demand. Even though the fertilizer industry is a volatile one, a tax on fertilizer feedstocks, which would marginally increase the price of fertilizers, is not likely to have a strong impact on farmers.

8.4 SUMMARY

The essence of the findings of this section are as follows:

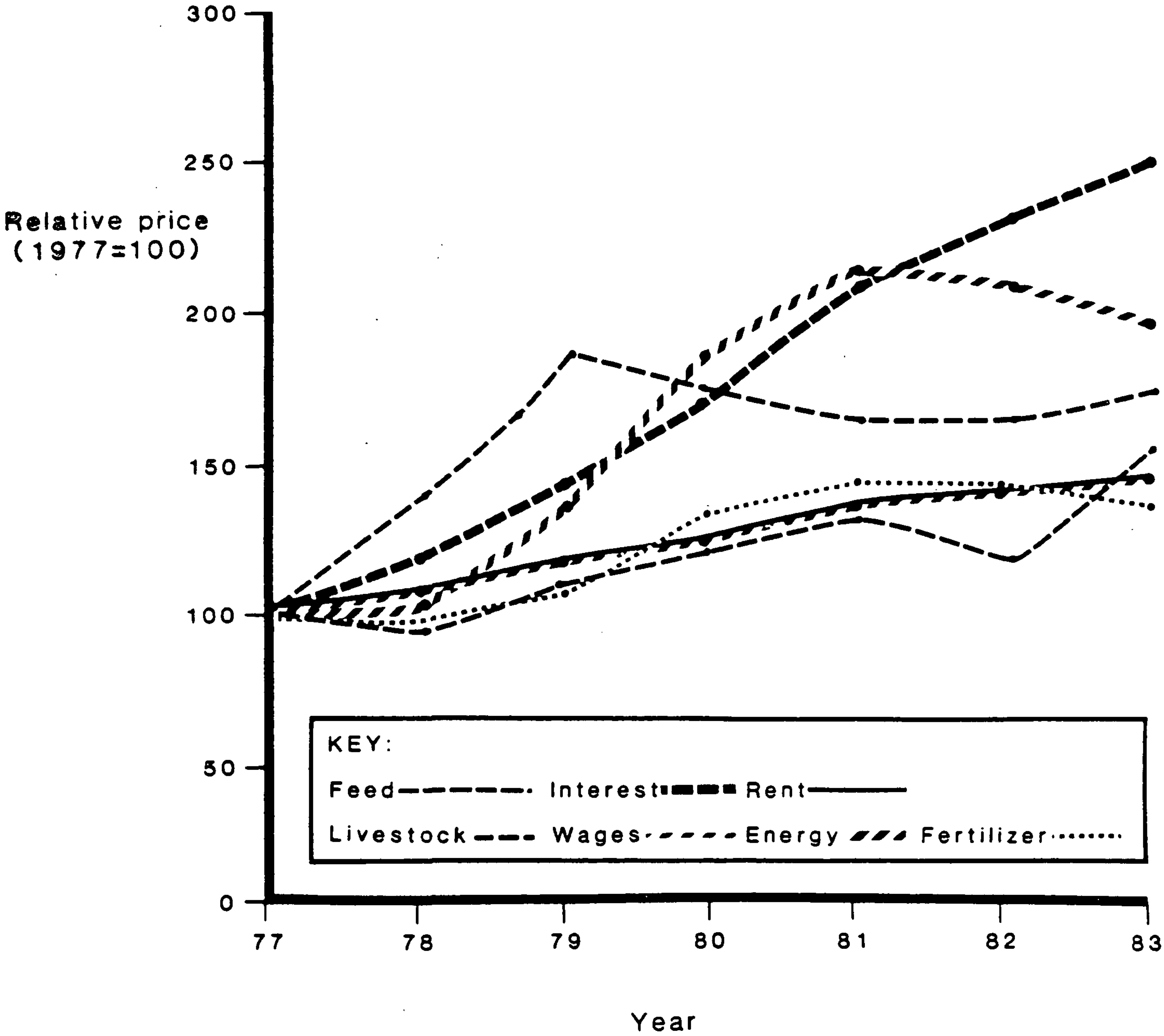
1. The fertilizer industry is entering a rebound period and appears to be facing relative prosperity, at least in the short-run.

2. Demand for fertilizers is relatively inelastic, and a tax at current rates would constitute only a small percentage of fertilizer prices. Therefore, the effects of a tax on fertilizer markets would likely not be great.

3. An increase in fertilizer prices due to the CERCLA tax at current rates would hardly be noticed by farmers because most farm inputs are subject to economic forces which dominate the feedstock tax at current rates.

EXHIBIT 8-6

INDEX OF PRICES PAID BY FARMERS (1977=100)



Source: "Agricultural Prices", U.S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board.

PART III: COAL-DERIVED SUBSTANCES

9. ECONOMIC IMPACT OF TAXING COAL-DERIVED SUBSTANCES

9.1 OVERVIEW AND FINDINGS

CERCLA Section 211 exempts from the CERCLA feedstock tax substances derived from coal. Section 301(a)(1)(I) requires an analysis of the economic impacts of taxing these substances. This chapter discusses those economic impacts.

The imposition of a tax on coal-derived substances would primarily affect two industries -- the metallurgical coke industry and the synthetic fuels industry. Over the next decade, the metallurgical coke industry is likely to be the larger industry affected, since synthetic fuels probably will be produced only on a limited commercial scale.

The first section presents an overview of the markets likely to be affected by any tax. The second section examines the largest industry to which the tax would most likely apply -- the metallurgical coke industry. The third section focuses on the emerging synthetic fuels industry. The final section summarizes the overall impacts of a tax on all industries producing taxable substances derived from coal.

Throughout this analysis, it is assumed that the only coal-derived substances that would be subject to the tax are those listed under Title II of CERCLA as taxable chemicals. In the case of coke oven by-products, these chemicals are benzene, toluene, xylene, naphthalene, and ammonia. For the coal-based synthetic fuel projects which may come on-line in the near future, only limited amounts of ammonia production would be subject to the tax. Production information is presented on all coal-derived substances for perspective and reference. However, for analyzing the impacts of removing the feedstock tax exemption for coat-derived substances, it is assumed here that the products subject to a tax are only those listed under Title II.

Depending upon the amount of substances produced, a feedstock tax could generate approximately $2 to $4 million annually. Ninety percent or more of this amount would be from coke oven by-products.

9.1.1 Metallurgical Coke Industry

In order to produce most of the steel in the United States, coke is required to reduce iron ore to pig iron before the steel can be formed. Coke itself is created from coal by heating the coal in the absence of air, a process called carbonization. In carbonization, the coal is reduced primarily to a carbon-based substance called coke. During this process, various chemicals are released from the coal that are often recovered for use elsewhere. Some of these by-products are used to make chemical feedstocks listed in Title II. If the exemption for coal-derived substances were eliminated, feedstocks produced from coal-derived substances would be taxed.

The elimination of the exemption would result in modest tax revenues, probably with little effects upon operations, other than possibly less on-site refining of crude by-products and light oil derivatives:

- The value of all products produced from coke oven by-products (but not necessarily sold) in 1980 was approximately $1.5 billion (in mid-1982 dollars). Those substances listed under Title II accounted for about 10 percent of this total value of production. Since many of the coke oven by-products are consumed on-site rather than sold, the substances listed under Title II comprise almost 25 percent of the commercial sales.

- If the exemption is eliminated, tax revenues from substances derived from coke oven by-products would be about $2 to $3 million annually, given the current taxes in Title II.

- Generally, a tax will not affect the amount of crude by-products recovered in the coke-making process. The objective in the coke industry is production of high-quality coke. Crude by-products are recovered as an ancillary benefit of coke-making, but the basic process is not altered to change the type and quantity of by-products produced.

- Some of the chemicals produced from coke oven by-products, such as the aromatic hydrocarbons, benzene, toluene, xylene, and naphthalene, must be refined from the crude substances recovered directly from the coke ovens. In recent years, the cost of refining these products has increased as the amount produced has declined with decreases in coke production. As a result, many operators have ceased their advanced refining processes, choosing instead to use the by-products internally (e.g., as fuel) or sell them in their crude stage to other refiners. Elimination of the CERCLA tax exemption could theoretically accelerate this trend and lead to a small reduction in the amount of coke oven by-products refined into CERCLA-taxed feedstocks. However, the market for these feedstocks would be affected only marginally, as they are dominated by petroleum-derived substances.

- The price that producers receive for their coal-derived substances is often determined by petroleum-derived substances. In most instances, the petrochemical industry produces substantially more of a particular product (or a close substitute). Producers of coal-derived substances typically accept the price set by other producers (i.e., the petrochemical industry), making it very difficult to pass on the cost of a feedstock tax in the form of higher prices. As a result, the tax would be an additional operating cost to the coke producers, a cost that would generally have to be absorbed by the U.S. steel industry.

- Not all of the steel produced in the U.S. requires coke. About 30 percent of U.S. steel production is from electric arc furnaces, which use virtually no coke to produce steel. As a result, steel produced from electric arc furnaces does not generate coal-derived chemicals. The proportion of total steel production from electric arc furnaces has been increasing in recent years and is likely to continue to do so since this process competes very effectively in several market segments with the more traditional, less efficient basic oxygen process (which does generate coal-derived substances). The potential tax revenues which would result from an elimination of the exemption are not likely to be large enough to affect significantly the comparative economics of steel production.

9.1.2 Synthetic Fuels Industry

Since the oil price increases in the early 1970's, there has been substantial interest in coal-based synthetic fuels projects that could convert coal to various liquid or gaseous fuels or other useable products. However, it now appears unlikely that the amount of coal-derived substances from synthetic fuels will be very significant in the near future. The high oil prices upon which many of the current synthetic fuels projects were predicated (e.g., $50-$70 per barrel and higher) are not expected to be realized any time soon. As a result, most proposed synthetic fuels projects have been indefinitely deferred or cancelled.

Most of the coal-based synthetic fuels projects still under consideration are likely to continue only if substantial funding is received from the United States Synthetic Fuels Corporation (SFC). That is, the cost of production for synthetic fuels is generally so far above current market prices (with little hope in the near-term that prices will rise sufficiently to cover costs) that projects are only going forward at this time if the SFC will subsidize them.

Most synthetic fuels projects do not produce substances that are considered taxable chemicals under Title II. For those few projects that would produce taxable chemicals, chiefly forms of ammonia, such taxes become additional operating costs that the project sponsors did not anticipate. Tax revenues resulting from up to three projects which may possibly come on-line and produce taxable substances would be less than $400,000 annually.

Since these projects are already subsidized, alternatives for the project sponsors would be to approach the SFC to obtain higher subsidies due to unforeseen operating expenses, accept a lower return on the project, or shut down. However, if only chemicals currently considered taxable according to

Title II are taxed, the cost impacts are likely to be minor. To the extent that a tax would encourage higher subsidy levels, which are already met through other federal taxes, the elimination of the exemption becomes a transfer among federal accounts.

One type of synthetic fuels production that may develop without federal subsidies is methanol production from coal. Currently, one project (the Tennessee Eastman project) is producing methanol from coal in order to produce acetic anhydride without funding from any other sources. However, acetic anhydride is not currently treated as a taxable chemical.

9.2 COAL-DERIVED SUBSTANCES FROM COKE OVENS

The primary producers of coal-derived chemicals in the United States are coke oven operators. These chemicals are produced as by-products of the coke-making process when coal is carbonized to form coke. Coke is one of the raw materials added into the blast furnace. The molten metal resulting from this process is used to produce steel in the basic oxygen furnace (BOF), or by the open hearth method, which together produce approximately 70 percent of the steel in this country.[1] Electric arc furnaces, which use virtually no coke, account for the remainder of domestic steel production.

The process by which the coke is formed is called carbonization. Exhibit 9-1 is a schematic representation of the coke-making and by-product recovery process.

As the coal is heated in the absence of oxygen in the coke ovens, various substances are emitted. These materials are derived primarily from the volatile constituents found in coal. While the coal is in the coke ovens, this volatile matter will become separated from the carbon-based portion of the coal. The carbon product that remains gradually softens until it becomes plastic, then is quenched (rapidly cooled) to form coke. The substances driven off are a combination of various tars, oils, and a medium-Btu gas (called coke oven gas).[2] Under most circumstances, it is characteristic for coke oven operators to recapture these by-products for commercial sale or use on-site. In some cases, the substances may simply be flared (burned off) or disposed of in some other fashion.

When the by-products of the coking process are first captured, they are typically in the form of crude tars, crude light oils, or a gas composed of

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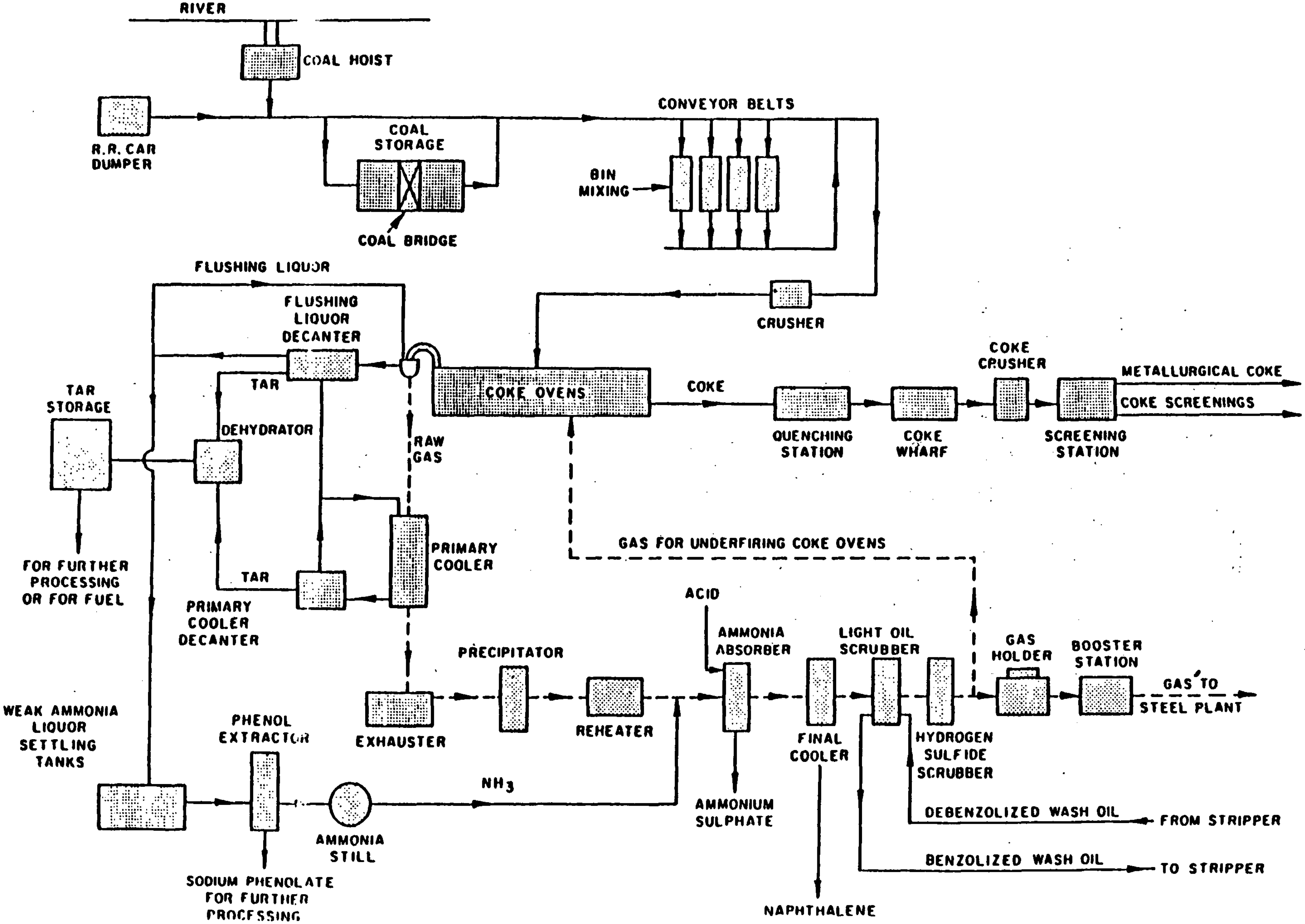
[1]The basic oxygen process accounts for most of the coke consumption (about 90 percent). The use of open hearths to produce steel is a very old technology and has been declining over the years as existing facilities are retired and not replaced.

[2]A medium-Btu gas contains approximately 200-900 Btu per cubic foot. A low-Btu gas contains less than 200 Btu per cubic foot and a high-Btu gas more than 900 Btu per cubic foot. Natural gas typically contains about 1,000 Btu per cubic foot.

EXHIBIT 9-1

RECOVERY OF BY-PRODUCTS FROM COKE OVENS



Source: McGannon, H.L. The Making, Shaping, and Treating of Steel (Pittsburgh: U.S. Steel, 1971) several different substances. In their crude form, these substances are not listed under Title II of CERCLA as taxable chemicals.

However, some coke oven operators will distill these materials into more refined products. For example, the crude light oils can be distilled into benzene, toluene, or xylene, which are listed as taxable chemicals. Similarly, the crude tars can be used to produce sodium phenolate, naphthalene, creosote oil, etc.

The coke oven operator will not always choose to produce these more refined products. In fact, for most coke oven operators, the amount of refined products that could be produced from their crude by-products is so small that further distillation on-site is not economical. For example, of the 60 coke plants operating during 1980, only 23 plants were involved in more advanced refining, with only 5 plants producing aromatic hydrocarbons (benzene, toluene, xylene or naphthalene).[3] The remaining operators will either use their crude by-products on-site or sell their supplies to other chemical producers for further refinement. Because many coke facilities do not generate enough by-products from the limited amount of coke they produce, most of the advanced refinement of coke by-products is actually done by the major steel producers such as Bethlehem Steel or U.S. Steel.

9.2.1 Amount and Value of Chemicals from Coke-Making in 1980

Exhibit 9-2 presents a summary of the market for coal chemicals from coke-making in 1980. Note that:

- The estimated commercial value of those by-products that were sold in 1980 is about $500 million. Nearly 40 percent of this revenue is due to the sale of crude tar, with crude light oil accounting for about another 20 percent. CERCLA feedstocks account for less than 25 percent of the total sold and approximately 10 percent of coke oven by-products produced.

- Most of the materials produced were left by coke oven operators in their crude stage (the original form in which they were produced) rather than processed further at the coke plant.

- The only substances produced from coke ovens that would be subject to the CERCLA feedstock tax if the exemption were removed are benzene, toluene, xylene,

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[3] Coke and Coal Chemicals in 1980, DOE/EIA 0120(80), p. 33-36. The number of advanced refining operations among coke producers has declined somewhat since 1980. In private discussions with coke producers, several have indicated that the diminishing market has forced them to abandon their more sophisticated refining operations.

EXHIBIT 9-2

COAL CHEMICAL MATERIALS PRODUCED AT UNITED STATES COKE PLANTS: 1980

Coal Chemical Materials	Quantity Produced	Sold: Quantity	Sold: Average Price Per Unit (dollars)	Sold: Value (thousand $)
Tar, Crude (thousand gallons)	534,068	357,156	$ 0.550/gal	$196,558
Tar Derivatives:				
Sodium Phenolate or Carbolate (thousand gallons)	1,146	1,035	0.158/gal	163
Crude Chemical Oil (tar acid oil, thousand gallons)	16,293	3,204	0.483/gal	1,546
Pitch of Tar (all grades, thousand short tons)	332	215	198.252/ton	42,695
Other Tar Derivatives a/ (short tons)	197,707	146,522	163/ton	23,887
Ammonia Products:				
Sulfate b/ (thousand short tons)	400	415	45.76/ton	18,978
Liquor (NH3 Content) (thousand short tons)	8	7	99.04/ton	736
Gas:				
Distributed Through City Mains (million cubic feet)	-	6,558	1.097/ thousand cu.ft.	7,194
Sold for Industrial Use (million cubic feet)	-	3,535	1.098/ thousand cu.ft.	3,880
Total Gas (million cubic feet) d/	724,058 c/	10,093	1.097/ thousand cu.ft.	11,074
Crude Light Oil (thousand gallons)	159,403 e/	103,085	1.073/gal	110,591
Intermediate Light Oil (thousand gallons)	8,825	2,510	1.120/gal	2,811
Light Oil Derivatives:				
Benzene (all grades, thousand gallons)	50,781	50,710	1.551/gal	78,534
Toluene (all grades, thousand gallons)	7,812	8,026	1.216/gal	9,756
Xylene (all grades, thousand gallons)	1,364	1,400	1.323/gal	1,852
Solvent Naphtha (all grades, thousand gallons)	1,252	1,217	0.705/gal	857
Other Light Oil Derivatives (thousand gallons)	4,544	2,863	0.697/gal	1,994
Total Light Oil Derivatives d/ (thousand gallons)	65,753	64,216	1.448/gal	92,994
Grand Total--Coal Chemical Materials	-	-	-	$502,033

a/ Includes creosote oil, naphthalene, and phenols. Note: DOE identifies these quantities in 1000 short tons; we believe this should have stated short tons.

b/ Includes di- and mono-ammonium phosphate.

c/ Includes gas used for heating ovens and gas wasted.

d/ Data may not add to totals shown because of independent rounding.

e/ Includes 58,120 thousand gallons refined by coke plant operators to make derived products shown.

Source: Coke and Coal Chemicals in 1980, DOE/EIA-0120(80).

napthalene, and ammonia.[4] In 1980, these substances were sold for about $115 million, or less than 25 percent of the value for all coke oven by-products sold.

- The production figures for crude light oil include that portion of the crude light oil refined into other products. Commercial values are shown for both the crude and the refined products because many coke plant operators will sell their crude oils to a larger coke facility for further processing, which then sells the upgraded product to someone else. In these circumstances, two different products have been sold during separate commercial transactions; hence, two estimates of market value are reported, one estimate for each product.

Not all of the by-product materials produced were sold. Some chemicals were either consumed at the facility for fuel or wasted. The amount sold varies by substance:

- If a chemical was not a direct by-product of coke-making, i.e., it had to be refined further in order to produce it (e.g., the derivatives), it was likely to be sold commercially.

- Nearly 99 percent of the coke oven gas produced was not sold. This gas is typically used on-site as an energy source.

If all of the by-products produced were valued at the average price for the portion sold, total value of production would have tripled to about $1.5 billion in 1980.[5] See Exhibit 9-3. Over one-half of the estimated market value of all coke oven by-products is due to coke oven gas. Those substances listed under Title II would have accounted for about 10 percent of this total value.

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[4]Naphthalene is part of the "other tar derivatives" category in Exhibit 9-2. The available data did not identify how much of the total was naphthalene. According to Synthetic Organic Chemicals: 1982 (U.S. International Trade Commission, No. 332-35), naphthalene production from coal tars since 1972 has ranged from 205,000 tons in 1982 to 116,000 tons in 1982. Value per ton was $130/ton in 1972 and $450/ton in 1982. Since this amount is most of the "other tar derivatives" category, we will assume all substances labelled as such are subject to the tax. It is a relatively small amount, so this assumption should not unnecessarily distort the analysis.

[5]This is probably a conservative estimate. In many instances, the coke oven by-products are consumed on-site in lieu of more expensive oil or gas. Their value is probably greater than the price indicated when sold as a raw product, where more refining is typically required to upgrade the value of the product.

The value of the by-products summarized in Exhibit 9-2 is not necessarily a good estimate of the future size of the market. The estimated value of the by-products from coke-making could change because:

- The various prices received for the by-products could fluctuate over time. These price changes could be in response to different production costs or changes in the prices paid for chemicals that compete with the coke by-products.

- The overall size of the metallurgical coal market could change as the demand for steel fluctuates or as process improvements lead to lower coke demand. A lower demand for coke would reduce the amount of by-products generated during coke-making.

Each of these possibilities will be discussed in turn.

A. Price Received for By-Products

The product values listed in Exhibits 9-2 and 9-3 are based on unit prices during 1980.[6] Over time, it is likely that these prices will change as the cost of producing the by-products changes with the price of metallurgical coal and as the prices of competing chemicals also change. Exhibit 9-4 lists the prices received for various coke oven by-products from 1972-1982.

During this period, the value of the by-products has generally increased. The sizes of the price increases are particularly significant following the world oil price increases of 1973 and 1979. These price increases are to be expected. Most of the chemicals produced in coke ovens compete with products that can be refined by the petrochemical industry, particularly the chemicals most likely to be taxed -- benzene, toluene, xylene, naphthalene, and ammonia. When the cost of the raw feedstock to petrochemical producers (i.e., petroleum) increases, the cost to produce chemicals will rise accordingly. This price increase allows the coke oven operator to charge a higher price for the by-products and remain competitive with oil-based products. As a result, the price received for coke oven by-products should closely track the price for petroleum-derived chemicals, and therefore, the price for crude oil.

B. Amounts of By-Products Produced

The amount of coke oven by-products produced will depend on the production of coke. As illustrated in Exhibit 9-5, coke production has been declining in

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[6]We have tried to use the most recent information available for this analysis. Unfortunately, much data originally reported are either no longer collected or are not reported in much detail. As a result, detailed data cited herein are often from 1980; the most recent data available at the time of this study are 1982 production information.

EXHIBIT 9-3

ESTIMATED VALUE OF ALL COKE OVEN BY-PRODUCTS PRODUCED: 1980 a/

Chemicals	Quantity Produced	Average Price Per Unit Sold (dollars)	Total Value of All Produced (10^3 dollars)	
			Sold	Produced
Tar, Crude (10^3 gals)	534,068	$ 0.55/gal	196,558	293,737
Tar Derivatives				
- Sodium Phenolate, Carbonate (10^3 gals)	1,146	0.158/gal	163	181
- Crude Chemical Oil (10^3 gals)	16,293	0.483/gal	1,546	7,870
- Tar Pitch (10^3 tons)	322	198.252/ton	42,695	63,837
- Other tar derivatives (10^3 tons)	198	163/ton	23,887	32,274
Ammonia Products: Sulfate (10^3 ton)	400	45.76/ton	18,978	18,990
Liquor (10^3 ton)	8	99.04/ton	736	792
Gas (10^6 cu. ft.)	724,058	1.097/10^3 cu. ft.	11,074	794,292
Crude Light Oil (10^3 gal)	159,403	1.073/gal	110,591	171,039
Intermediate Light Oil (10^3 gal)	8,825	1.120/gal	2,811	9,884
Light Oil Derivatives (10^3 gal)	65,753	1.448/gal	92,994	95,210
			502,033	1,488,106

a/ Using 1980 production quantities and prices paid in 1980 for materials actually sold.

EXHIBIT 9-4

AVERAGE PRICE PER UNIT FOR COKE OVEN BY-PRODUCTS: 1972-1982
(Dollars Per Unit Indicated)

Coal Chemical Materials	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Tar, Crude (per gallon)	0.116	.124	.311	.347	.332	.365	.376	.487	.550	.817	.715
Gas (thousand cubic feet)	.269	.319	.521	.555	.747	.891	.741	.794	1.097	1.514	1.384
Crude Light Oil (per gallon)	.110	.141	.417	.447	.502	.532	.468	.794	1.073	1.154	.891
Intermediate Light Oil (per gallon)	.093	.097	.212	.352	.282	.317	.530	1.039	1.120	1.342	.680
Light Oil derivatives (per gallon)	.202	.255	.705	.701	.744	.738	.558	1.133	1.448	1.550	N.A.

N.A. = not available.

Source: Coke and Coal Chemicals: 1972-1975, (U.S. Department of the Interior, Bureau of Mines)
Coke and Coal Chemicals: 1976-1980, DOE/EIA-0120(76-80)
Coke Plant Report: October-December 1981, DOE/EIA-0121(81/4Q)
Quarterly Coal Report: January-March 1983, DOE/EIA-0121(83/1Q)

EXHIBIT 9-5

AMOUNT OF COKE AND COAL CHEMICALS PRODUCED IN U.S. COKE OVENS: 1974-1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Coal Carbonized (10^6 tons)	90.2	83.6	84.7	77.7	71.4	77.4	66.7	61.0	40.9
Coke Produced (10^6 tons)	61.6	57.2	58.3	53.5	49.0	52.9	46.1	42.8	28.1
Crude Tar (10^6 gal)	677.4	645.5	636.4	592.4	540.6	591.5	534.1	472.2	316.4
Coke Oven Gas (10^9 cu. ft.)	967.2	895.3	912.4	841.4	782.2	834.3	724.1	636.9	427.7
Crude Light Oil (10^6 gal)	217.4	194.8	198.1	178.4	161.8	175.2	159.4	147.0	94.5

Source: Coke and Coal Chemicals: 1974-1975 (U.S. Department of the Interior, Bureau of Mines)

Coke and Coal Chemicals: 1976-1980, DOE/EIA-0120(76-80)

Coke Plant Report (October-December 1981), DOE/EIA-0121(81/4Q)

Quarterly Coke Plant Report, January-March 1983, DOE/EIA-0121(83/1Q) recent years, resulting in less production of coke oven by-products. The production of coke is likely to remain at relatively low levels in future years for several reasons:

- The U.S. steel industry is coming out of the recent recession as a much smaller industry. Many plants have been permanently closed and others may be closed over the next several years. Steel has been displaced in some market by other metals such as aluminum and by synthetic materials such as plastics in many uses. Steel imports have increased their share of the U.S. market to about twenty percent and may continue to grow.

- The market share held by basic oxygen furnaces and the older open-hearth furnaces will decline as older facilities close. These facilities produce steel by using molten metal from blast furnaces, which use coke to help reduce iron ore to pig iron for the production of steel. Electric furnaces, which do not require coke formed from metallurgical-grade coal, are expected to increase their market share. As a result, the demand for coke will be reduced, regardless of whether or not the CERCLA tax exemption is maintained.

- Further improvements in blast furnace design and operation will continue to lower the coke rate, defined as the ratio of the amount of coke consumed to the amount of iron produced.[7]

- Less raw steel will be needed to produce finished products. More steel plants are installing continuous casting equipment and are realizing better yields from raw steel in addition to other improvements in productivity and energy efficiency. Continuous casting accounted for less than 10 percent of U.S. raw steel production in 1975 and accounts for nearly 30 percent today. By 1990, such machines may pour up to 75 percent of U.S. steel. This in turn could raise the ratio of finished steel to raw steel from 75 percent in 1980 up to nearly 80 percent by 1990, which would mean less raw steel would have to be produced to satisfy demands for steel in finished products.

9.2.2 Potential Tax Revenues from Coke Oven By-Products

The potential amount of revenues raised in the future as a result of a tax on coke oven by-products will depend on three factors:

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[7]These improvements include improved coke burdens and burden sizing, reduced slag rates, improved coke strengths, higher top pressures, and the phase-out of obsolete furnaces.

- the chemicals subject to the tax;
- the tax rate; and
- the forecasted amount of the by-products generated.

Chemicals Subject to Tax: In the event that the CERCLA feedstock tax exemption is rescinded for coal-derived substances, we have assumed that the only coal-derived sustances that would actually be taxed are those currently defined as taxable chemicals according to Title II. Since some consideration has been given to expanding the list of taxable chemicals, we have provided production estimates for all coal-derived substances. However, the estimated tax revenues developed in this chapter are calculated only for those chemicals currently taxed. In the case of coke oven by-products, these chemicals are benzene, toluene, xylene, naphthalene, and ammonia.

Tax Rate: For purposes of this analysis, it will be assumed that the tax rate remains unchanged from the levels defined in Title II of CERCLA. For four of the five taxable chemicals produced from coke ovens -- benzene, toluene, xylene, and naphthalene -- this rate is $4.87 per ton. For ammonia, it is $2.64 per ton.[8]

Amount of By-Products: As indicated earlier in Exhibit 9-5, the amount of coke oven by-products produced has been declining in recent years. Even though steel demand may increase in the near future, the demand for coke is likely to remain depressed. To capture the uncertainties associated with the amount of coke demand through 1990, and therefore, the amount of by-products recovered, "low" and "high" production cases have been developed:

- In 1980, approximately 46 million tons of coke were produced. This level of coke demand is relatively consistent with several forecasts, including DOE's recent Fourth National Energy Policy Plan. The amount of coke oven by-products that resulted from this level of coke demand will be treated as the "low production" case.

- Domestic steel production in 1973 was at its highest level ever, with about 65 million tons of coke produced. The amount of by-products generated from this level of demand will be referred to as the "high production" case. For a few by-products such as tar

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[8] Ammonia is excluded from taxation if used to make fertilizer. Since the end-use of ammonia from coke ovens is not known, we will assume it is taxable. Ammonia accounts for a small percentage of the value of the five taxable chemicals; accordingly, this assumption should not unnecessarily distort the analysis. In fact, because 80 percent of ammonia produced is used for fertilizer, this assumption helps to ensure that potential tax revenues are not understated.

acid oil, ammonia liquor, intermediate light oil, and other light oil derivatives, 1973 production was less than 1980 production; for these items, 1980 production will be used for the high production case as well.

The production levels that result from these scenarios are listed in Exhibit 9-6. In addition to listing these quantities in the usual production units of each by-product, this exhibit also converts the production levels into thousands of tons.

Potential Tax Revenues from Coke Oven By-Products: The tax rate assumed to apply to coke oven by-products if the exemption is removed is $4.87 per ton for the four aromatic hydrocarbons and $2.64 per ton for ammonia. These rates are applied to both the high and low production estimates to determine a range of potential tax revenues for each production scenario.

The potential range of revenues that would be generated from these rates is illustrated in Exhibit 9-7 for the coke oven by-products that would be subject to the tax -- benzene, toluene, xylene, naphthalene, and ammonia. These tax revenues are shown for the high and low production cases discussed in this analysis. Ppotential tax revenues could range from about $2 to $3 million annually from coke oven by-products.

9.2.3 Impact of Tax on Coke Oven By-Products

As mentioned earlier, the recovery of by-products from coke ovens is an ancillary result of the coke-making process. In the course of carbonizing coal to form coke, the by-products are emitted as waste products. Rather than just dispose of the various substances, coke operators have been able to recycle them for internal use or commercial sale. In some instances, these crude by-products are refined into aromatic hydrocarbons such as benzene, toluene, xylene, and naphthalene. If a tax is imposed on these refined by-products, what effect is it likely to have on the level of production? Also, what is the likelihood that the tax will be passed on to the consumer in the form of higher prices?

Effect on Production: Exhibit 9-8 compares the cost that coke plants must pay for the metallurgical coal they carbonize versus the value of the chemicals sold commercially (excluding on-site use). Note that:

- The commercial sale of the coke by-products generates enough revenue to cover a significant portion of the costs of the metallurgical coal (typically 10-20 percent).

- The substances that would be taxed if the exemption was eliminated accounted for less than 25 percent of the commercial sales.

EXHIBIT 9-6
PRODUCTION LEVELS FOR COKE OVEN BY-PRODUCTS

	Low Production Case a/		High Production Case b/	
	Production Units	10^3 Tons	Production Units	10^3 Tons
Crude Tar (10^3 gal)	534,068	2,537	732,455	3,479
Tar Derivatives:				
Sodium phenolate or carbolate (10^3 gal)	1,146	6	2,922	16
Tar acid oil (10^3 gal)	16,293	71	16,293 d/	71 d/
Pitch of Tar (10^3 tons)	322	322	525	525
Other tar derivatives (10^3 tons)	198	198	271 c/	271
Ammonia Products:				
Sulfate and Diammonium Phosphate (10^3 tons)	400	400	600	600
Liquor--NH_3 Content (10^3 tons)	8	8	8 d/	8 d/
Coke Oven Gas (10^6 cu. ft.)	724,058	10,861	994,916	14,924
Crude Light Oil (10^3 gal)	159,403	577	226,109	818
Intermediate Light Oil (10^3 gal)	8,825	33	8,825 d/	33 d/
Light Oil Derivatives (10^3 gal)				
Benzene	50,781	186	89,175	327
Toluene	7,812	28	14,496	52
Xylene	1,364	5	3,104	11
Solvent Naphtha	1,252	5	2,306	11
Other Light Oil Derivatives	4,544	17	4,544	17 d/

a/ 1980 quantities of by-products produced.
b/ 1973 quantities of by-products produced.
c/ Data were not available. Quantity indicated is an estimate based on ratio of 1973 to 1980 crude tar production, i.e., 732,455,000 gals/534,068,000 gals.
d/ Production in 1973 was below 1980 levels. For high production case, 1980 quantities produced were used.

Sources: Coke and Coal Chemicals in 1973, (U.S. Department of the Interior, Bureau of Mines); Coke and Coal Chemicals in 1980, DOE/EIA-0120(80).

EXHIBIT 9-7

RANGE OF POTENTIAL TAX REVENUES FOR COKE OVEN BY-PRODUCTS PRODUCED

(thousands of mid-1982 dollars)

	Low Production	High Production
Tar Derivatives		
Naphthalene	964.3	1,319.8
Ammonia	21.1	21.1
Light Oil Derivatives		
Benzene	905.8	1,592.5
Toluene	136.4	253.2
Xylene	24.4	53.6
Total Potential Tax Revenues	$2,052.0	$3,240.2

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a/ Assumes tax rate of $4.87 per ton for the aromatic hydrocargons and $2.64 per ton for ammonia liquor.

EXHIBIT 9-8

VALUE OF COKE OVEN BY-PRODUCTS SOLD AS AMOUNT OF COAL COSTS RECOVERED
(nominal dollars per ton of coal carbonized)

	1975	1976	1977	1978	1979	1980	1981	1982
Average Cost/Ton Coal Carbonized	$44.21	$44.16	$46.24	$52.05	$50.69	$56.33	$62.70	$65.05
Value of Coal Chemicals Sold								
Crude Coal Tar	1.20	1.15	1.39	1.68	2.26	2.95	4.85	4.03
Tar Derivatives	.42	.51	.49	.51	.72	1.02	1.68 b/	1.40 b/
Gas	3.55	4.80	5.80	.51 a/	.12	.17	.39	.22
Ammonia Products	.40	.35	.41	.37	.37	.30	.32	.41
Crude Light Oil	.54	.63	.65	.61	1.13	1.66	2.25	1.53
Int. Light Oil	.01	.01	.01	.05	.04	.04	-	-
Light Oil Derivatives	.70	.65	.76	.65	1.06	1.40	1.01	.68
Total	6.82	8.10	9.51	4.38	5.70	7.54	10.50	8.27
As Percent of Coal Cost	15%	18%	21%	8%	11%	13%	17%	13%

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a/ From 1978 on, values for certain uses of gas are no longer reported; the value given is just for gas distributed through city mains and sold for industrial use.

b/ The values for tar and light oil derivatives have been estimated, based on the percent change from the previous year in the values of crude coal tar and crude light oil.

Sources: Coke and Coal Chemicals in 1975 (U.S. Department of the Interior, Bureau of Mines).
Coke and Coal Chemicals: 1976-1980, DOE/EIA-0120(76-80).
Coke Plant Report (October-December 1981), DOE/EIA-0121(81/4Q)
Quarterly Coal Report (January-March 1983, DOE/EIA-0121(83/1Q)

- The increase in the value of the by-products over time has helped to offset any increases in the cost of metallurgical coal. The value of these by-products has increased as the cost of substitute chemicals has risen, primarily as a result of the increase in world petroleum prices.

Moreover, Exhibit 9-8 accounts only for that portion of recovered by-products sold commercially. If the value of all chemicals produced is included, over one-third of the cost of the metallurgical coal may be recovered, as shown in Exhibit 9-9.[9] Much of this increase in recovered costs is due to coke oven gas, which is typically consumed on-site in the coke ovens or at the nearby steel plant.

The high value of coke oven by-products generally encourages their recovery. In order to assess whether a tax on some of the refined by-products would affect the market for coke oven by-products, several observations on coke industry operations should be emphasized:[10]

- The crude coke oven by-products (i.e., the basic tars, oils, coke oven gas, and ammonia products) are a natural result of the coke-making process. Their recovery is relatively simple and inexpensive as long as the coke is going to be produced in the first place.

- The amount of each crude by-product recovered is a function of the type of metallurgical coal from which the coke is derived and the type of coking process employed. These variables are not changed in order to produce different by-products. The main objective is producing high quality coke; any by-products recovered are only incidental to this goal.

- Some of the products produced from by-products (e.g., the different tar and light oil derivatives) can only be recovered by more advanced refining techniques. This category includes most substances that would be subject to the CERCLA feedstock tax if the exemption were removed. Many coke plants do not generate enough by-products to warrant further refining. They will either use the crude by-products or sell them to a larger coke operation for further refining.

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[9]For those by-products consumed on-site, their value was assumed to be equivalent to the values reported for those chemicals sold commercially.

[10]These points were mentioned on many occasions during conversations with the operators of several coke plants.

EXHIBIT 9-9

VALUE OF TOTAL COKE OVEN BY-PRODUCTS PRODUCED AS AMOUNTS OF COAL COSTS RECOVERED
(nominal dollars per ton of coal carbonized)

	1975	1976	1977	1978	1979	1980	1981	1982
Average Cost/Ton Coal Carbonized	$44.21	$44.16	$46.24	$52.05	$50.69	$56.33	$62.70	$65.05
Value of Coal Chemicals Produced								
Crude Coal Tar	2.72	2.52	2.81	2.85	3.72	4.41	6.32	5.53
Tar Derivatives	.56	.60	.61	2.50a/	1.65	1.56	2.24b/	1.96
Gas	6.03	8.14	9.73	8.12	8.56	11.92	15.80	14.47
Ammonia Products	.49	.31	.41	.41	.36	.29	.36	.41
Crude Light Oil	1.06	1.19	1.23	1.06	1.80	2.57	2.78	2.06
Intermediate Light Oil	.02	.02	.02	.06	.15	.15	.09	.05
Light Oil Derivatives	.70	.68	.77	.64	1.10	1.43	.99 c/	.73
Total	$11.58	$13.46	$15.58	$15.64	$17.34	$22.33	$28.58	$25.20
As Percent of Coal Cost	26%	30%	34%	30%	34%	40%	46%	39%

a/ From 1978 on, values for certain tar derivates are reported, which prior to 1978 were listed as not available.

b/ The values for tar and light oil derivatives have been estimated based on the percent change from the previous year in the values of crude coal tar and crude light oil.

c/ The only derivatives reported are benzene, toluene, and xylene.

Sources: Coke and Coal Chemicals in 1975 (U.S. Department of the Interior, Bureau of Mines)
Coke and Coal Chemicals: 1976-1980, DOE/EIA-0120(76-80)
Coke Plant Report: (Oct-Dec 1981), DOE/EIA-0121(81/4Q)
Quarterly Coal Report: (Jan-Mar 1983), DOE/EIA-0121(83/1Q)

- Even for those coke operations that can obtain enough by-products to justify further refining, other factors often tend to discourage them from doing so. For example, the cost of pollution control may put coke oven operators at a competitive disadvantage vis-a-vis petroleum refiners. In the case of the aromatic hydrocarbons -- benzene, toluene, xylene, and naphthalene -- coke producers must eliminate sulfur to compete with the petroleum-based products. Petroleum refiners must also remove the sulfur, but it is typically removed much earlier in the refining process at considerably less expense. The cost of this refining to coke oven operators has often discouraged them from producing the hydrocarbons.

This last point can be seen in Exhibit 9-10, which compares over time the production of the aromatic hydrocarbons benzene, toluene, and xylene by type of producer. Petroleum refiners have been the primary producers of aromatic hydrocarbons.[11] As the demand for these substances has increased, petroleum refiners have responded with greater production. For coke-oven operators, their market share has declined substantially, more than would be indicated by the decrease in coke production.

Presumably, the increases in oil prices in 1979 would have improved the economic outlook for hydrocarbons from coke oven operations. However, the data for 1980 and 1981 do not indicate any resurgence in the level of production. Several coke oven operators have noted that the limited supplies available for further refining have reduced the size of previous operations, thereby diminishing some of the economies of scale. Also, recent pollution control costs associated with the process have made more advanced refining less economical. The relative economics of refining these hydrocarbons from coke oven by-products vis-a-vis petroleum-based production will depend on many site-specific factors that are beyond the scope of this study. However, to the extent that coke oven operators have already been reducing their level of advanced refining, any tax may only serve to hasten this trend toward less production of aromatic hydrocarbons from coke oven by-products.

However, even if a feedstock tax caused coke oven operators to reduce further their production of aromatic hydrocarbons, it is unlikely that such a move would have any significant effect on the total market for these substances. As noted, except for naphthalene, coke oven by-products satisfy only a very small portion of total demand for aromatic hydrocarbons. Over the last several years the petrochemical industry has demonstrated that it can substantially expand or contract the supply of these substances to meet market

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[11]The market is somewhat different for naphthalene. About 60 percent of the market is supplied by coal-based tars, the remainder by petroleum sources. However, total market demand for naphthalene has been falling in recent years, even though the price received for the product has increased.

EXHIBIT 9-10

PRODUCTION OF AROMATIC HYDROCARBONS BY SOURCE

	1967 a/	1970	1975	1979	1980	1981	1982
Amount of Coke Produced (10^6 tons)	64.0	66.5	57.2	52.9	46.1	42.8	28.1
Benzene (10^6 gal)							
Coke Oven Operators	90.6	100.0	65.0	60.9	50.8	31.4	16.8
Petroleum Refiners	878.7	1,150.0	959.0	1,611.7	1,533.8	1,307.7	1,051.9
Total	969.3	1,250.0	1,024.0	1,672.7	1,584.6	1,339.2	1,068.7
Coke Oven Market Share (%)	9.3	8.0	6.3	3.6	3.2	2.3	1.6
Toluene (10^6 gal)							
Coke Oven Operators	19.4	19.0	10.0	9.2	7.8	4.8	1.4
Petroleum Refiners	624.5	667.0	695.0	1,000.7	1,009.5	851.6	714.1
Total	643.8	686.0	705.0	1,009.9	1,017.3	856.5	715.5
Coke Oven Market Share (%)	3.0	2.8	1.4	0.9	0.8	0.6	0.2
Xylene (10^6 gal)							
Coke Oven Operators	5.5	5.0	1.9	1.4	1.4	0.7	0.2
Petroleum Refiners	449.3	449.0	637.0	970.8	907.2	881.8	657.7
Total	454.8	454.0	638.9	972.2	908.5	882.4	658.0
Coke Oven Market Share (%)	1.2	1.1	0.3	0.1	0.2	0.1	0.05

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a/ Base year for Federal Government production indices.

Source: Synthetic Organic Chemicals: 1981, p. 10.
Synthetic Organic Chemicals: 1980, p. 11.
Synthetic Organic Chemicals: 1982, p. 9.
Quarterly Coal Report, April-June 1983, p. 52.

demand (see Exhibit 9-10). This capability to adjust to changing market conditions has been far greater than the total amount of aromatic hydrocarbons produced from coke oven by-products. In the case of naphthalene, declining market demand for the substance has discouraged petrochemical companies from expanding production.

Exhibit 9-11 provides further evidence that the imposition of a tax on the aromatic hydrocarbons refined from the curde coke oven by-products is unlikely to affect the amount of production of the crude substances. This exhibit compares the amount of coke oven by-products produced to the price actually received for the substance. Note that:

- Although the real prices for coke oven by-products have been increasing in recent years, the amount of these substances produced has actually been declining. As discussed earlier (see section 9.2.1), this decline in the amount of by-products recovered is due to the decline in the domestic steel industry, not to the prices received for the substances.

- The amount of each crude substance produced from each ton of coke produced has remained relatively constant over time. Presumably, if coke oven operators had the flexibility, they would alter the amount of each by-product produced as the price for each substance changed. However, as prices have increased over time, coke oven operators have not altered the relative mix of by-products recovered.

These trends indicate that the production of crude coke oven by-products is inelastic relative to the price received for the substances. The prices have increased in real terms, yet total production has declined and the rate of production has remained fairly constant. Since the rate of production has remained steady over a broad price range (significantly greater than the amount of the proposed tax on the aromatic hydrocarbons), the supply of these crude substances should not change if a tax is imposed on some of the chemicals that can be refined from the crude by-products.

Effect of Tax on Prices: If a tax is imposed on some of the refined by-products from coke-making, the coke oven operator would prefer to pass the tax on to the consumer in the form of higher prices. However, it is unlikely that the operator will be able to do so. It is beyond the scope of this analysis to provide a detailed assessment of the amount of the tax for each specific by-product that will be included in the price of the product. Nevertheless, several points should help clarify the possibility of higher product prices due to a tax:

- As discussed previously, most of the by-products from coke ovens compete with similar substances that can also be derived from petroleum. For many substances, most of the market is composed of petroleum-derived chemicals

EXHIBIT 9-11

PRODUCTION OF COKE OVEN BY-PRODUCTS COMPARED TO THE PRICE RECEIVED

Coke Oven By-Product	1974	1975	1976	1977	1978	1979	1980	1981	1982
Crude Tar									
Amount Produced (10^6 gal)	677.4	645.5	636.4	592.4	540.6	591.5	534.1	472.2	316.4
Gallons/Ton Coke Produced	11.0	11.3	10.9	11.1	11.0	11.2	11.6	10.1	11.3
Price per Gallon (mid-1982 $)	0.54	0.57	0.52	0.54	0.52	0.62	0.64	0.88	0.72
Crude Light Oil									
Amount Produced (10^6 gal)	217.4	194.8	198.1	178.4	161.8	175.2	159.4	147.0	94.5
Gallons/Ton Coke Produced	3.5	3.4	3.4	3.3	3.3	3.3	3.5	3.1	3.4
Price per Gallon (mid-1982 $)	0.72	0.74	0.79	0.79	0.65	1.01	1.25	1.24	0.89
Coke Oven Gas									
Amount Produced (10^9 cu. ft.)	967.2	895.3	912.4	841.4	782.2	834.3	724.1	636.9	427.7
Thousand cu. ft./Ton of Coke Produced	15.7	15.7	15.7	15.7	16.0	15.8	15.7	13.6	15.2
Price per thousand cu. ft. (mid-1982 $)	0.90	0.92	1.17	1.32	1.02	1.01	1.28	1.62	1.38

Source: From Exhibits 9-4 and 9-5.

(e.g., see Exhibit 9-13). As a result, coke oven operations are price-takers, where the price of coal-derived chemicals will usually depend on the price for the petroleum-derived counterparts.

- The substances produced from coke ovens that would be subject to a tax if the exemption were removed are already subject to a tax if petroleum-derived, including benzene, toluene, xylene, ammonia, and naphthalene. The prices currently received for these chemicals presumably reflect the amount of the tax passed on to the consumer (i.e., to the extent that prices have increased as a result of the tax on petroleum-based substances, coke oven operators are already able to charge a higher price).

Given these considerations, coke operators will generally not be able to pass the tax on in the form of higher prices. As a result, the cost of the tax will come out of the profits of the steel industry (which operates most coke ovens). Since the prices received by steel producers for their products are heavily influenced by foreign competition and newer, more efficient domestic electric arc furnaces, a tax is unlikely to be passed on in the form of higher steel prices. The extent to which trade policy may shield the domestic integrated steel producers was considered beyond the scope of this analysis.

9.3 COAL-DERIVED SUBSTANCES FROM SYNTHETIC FUEL OPERATIONS

The amount of coal-derived substances from synthetic fuel operations is likely to be quite limited for the next several years. As the development costs of most synthetic fuel projects have risen over time, the continued escalation of oil prices that was expected to make coal-based synthetic fuels development economic has not materialized, causing nearly all projects to be cancelled or indefinitely deferred.

At this time, only a select handful of projects are moving forward, with most of these considered likely to reach the production stage only if substantial funding is received from the U.S. Synthetic Fuels Corporation (SFC). With the funding policies of the SFC coming under severe scrutiny during the past several months, there has been much discussion over substantially reducing the funding authority of the SFC. Further funding cuts would lower the amount of synthetic fuels likely to be produced.

From those projects still under active consideration, Exhibit 9-12 lists those coal-related synfuel projects that are or soon could be producing synthetic fuels. Note that most substances produced from synthetic fuel operations are not subject to the CERCLA feedstock tax according to Title II. Because these projects are relatively far advanced toward commercial production, they can be treated as a reasonable lower bound estimate of synthetic fuels development. Of these four projects, only the Tennessee Eastman Project in Kingsport, Tennessee, is totally funded by private sources

EXHIBIT 9-12

COAL-BASED SYNTHETIC FUEL PROJECTS MOST LIKELY TO ACHIEVE COMMERCIAL PRODUCTION

Plant Name	Product Produced	Amount Scheduled to be Produced
Tennessee Eastman Co.	Acetic Anhydride a/	500 million lbs/year
Cool Water Coal Gasification Program	Medium-Btu Gas b/	5,600 million cubic feet/year
Great Plains Coal Gasification Project	Synthetic Natural Gas (minimum 977 Btu)	31,250 million cubic feet/year
	Anhydrous Ammonia	23,250 tons/year
	Sulfur	22,000 tons/year
	Glauber's Salt	7,750 tons/year
	Tar (used for fuel)	35,750,000 gallons/year
	Phenols (used for fuel)	5,000,000 gallons/year
	Naphtha (used for fuel)	4,750,000 gallons/year
Dow Syngas	Medium Btu Gas b/	8 trillion Btu/year

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a/ Methanol is produced initially, then converted to acetic anhydride.

b/ Medium-Btu Gas: A gas with a heating value ranging from 200 to less than 900 Btus per cubic foot (normal range 200 to 500).

c/ Low-Btu Gas: A gas with a heating value up to 200 Btu per cubic foot.

(i.e., Eastman Kodak). Of the three other projects, production plans are contingent on substantial financial support from the SFC. At the time of time analysis, all projects except the Dow Syngas Project in Plaquemine, Louisiana, had started production or were close to starting.

However, if only chemicals currently considered taxable according to Title II are taxed, the impacts are likely to be minor. The potential range of tax revenues from the four projects listed in Exhibit 9-12 is shown in Exhibit 9-13. Given the current list of taxable chemicals, only the Great Plains Coal Gasification Project would incur any tax liability. Since this project produces about 23,250 tons of ammonia per year, at a tax rate of $2.64 per ton, potential tax revenues that would be generated from the most likely coal-derived synthetic fuel projects were about $60,000 annually.

Exhibit 9-14 expands the list of synthetic fuel projects in Exhibit 9-12 to include other coal-derived synthetic fuel projects that have been given serious consideration but are less likely to commit to actual production in the current market. Most of the projects would require SFC funding approval before actual project construction will start. This list is treated as a reasonable upper bound on the amount of synthetic fuels production from coal likely through 1990. However, it is highly unlikely that all of these projects will proceed. According to the SFC, most coal-related synthetic fuel projects are very expensive given the amount of fuel they produce. As a result, it is unlikely that more than two or three of these projects will receive sufficient funding to consider full-scale operations.[12]

If all of these projects do reach full production, Exhibit 9-15 shows the potential tax revenues that could be generated from each project. The potential tax revenues amount to about $375,000 million annually.

These projects will produce at a cost substantially above market price, hence, they will not be able to pass on the cost of a tax. The SFC is already subsidizing the cost of production. Any increase in costs could only be recouped by an increase in the level of SFC funding, which is already supported with other tax revenues.

If such support is not forthcoming, it is not clear what actions the synthetic fuel projects would take. In order to remain in operation, the firm(s) operating the project would have to be willing to absorb the total tax liability as an operating loss. Given the size of the feedstock tax liabilities (discussed below), most firms would probably absorb the cost rather than abandon a multi-million dollar investment in synthetic fuels development.

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[12]Personal communication with Joseph Keefer, August 23, 1983, National Council for Synthetic Fuels Production. Given recent proposals to reduce substantially SFC funding authority, even this amount may be optimistic.

EXHIBIT 9-13

TOTAL VALUE OF ANNUAL TAX REVENUES
FROM SYNFUEL PRODUCERS:
LOW PRODUCTION CASE
(10^3 mid-1982 dollars)

Plant	Product	Tax Liability
Great Plains	Anhydrous Ammonia	61.4
Total Annual Potential Tax Revenues		61.4

EXHIBIT 9-14

EXPANDED LIST OF POTENTIAL SYNTHETIC FUEL PLANTS: HIGH PRODUCTION CASE

Plant	Product
Tennessee Eastman Co.	Acetic Anhydride
Great Plains	Natural Gas Anhydrous Ammonia Sulfur Glauber's Salt Phenols Naphtha Tar
Cool Water	Medium-Btu Gas
Dow Syngas	Medium-Btu Gas
Keystone Project	Methanol
North Alabama Coal Gasification Consortium	Methanol
Hampshire Energy	Unleaded Gasoline Anhydrous Ammonia (85,000 tons/year)
Tennessee Valley Authority	Ammonia (33,750 tons/year)
Basic Resources Inc.	Dry Gas (230 Btu/cubic foot)
Elgin Butler Brick Co.	Low-Btu Gas
World Energy Inc.	Synthesis Gas Light Oils
Arkansas Power & Light Co.	Medium-Btu Gas

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a/ Hampshire Energy intended to produce a mixture of LPG and ammonia. For this analysis it is all assumed to be ammonia.

EXHIBIT 9-15

TOTAL VALUE OF ANNUAL TAX REVENUES FROM SYNTHETIC FUEL PRODUCERS: HIGH PRODUCTION CASE

(10^3 mid-1982 dollars)

Project	Product	Tax Liability
Great Plains	Anhydrous Ammonia	61.4
Hampshire Energy	Anhydrous Ammonia	224.4
Tennessee Valley Authority	Ammonia	89.1
Total Annual Potential Tax Revenue		374.9

9.4 TOTAL POTENTIAL TAX REVENUES

Exhibit 9-16 summarizes the range of potential tax revenues that could be generated from coal-derived substances if the exemption from the CERCLA feedstock tax were eliminated. Depending on the amount of substances produced, a feedstock tax on these substances could generate approximately $2 to less than $4 million annually.

EXHIBIT 9-16

TOTAL VALUE OF ANNUAL TAX REVENUES FROM COAL-DERIVED SUBSTANCES

(10^3 mid-1982 dollars)

	Low Production Scenario	High Production Scenario
Coke Oven By-Products a/	2,052.0	3,240.2
Synthetic Fuels	61.4 b/	374.9
Total Potential Tax Revenues	2,113.4	3,615.1

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a/ 'From Exhibit 9-7.

b/ From Exhibit 9-13.

c/ From Exhibit 9-15.