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MINERAL ISSUES •MINERAL ISSUES •MINERAL ISSUES • MINERAL ISSUES

THE MINERALS RELATED IMPLICATIONS OF A DIRECT TAX ON U.S. PRIMARY LEAD PRODUCTION AND PRIMARY LEAD IMPORTS

NITED STATES DEPARTMENT OF THE INTERIOR • BUREAU OF MINES

Mineral Issues April 1993

The Minerals Related Implications of a Direct Tax on U.S. Primary Lead Production and Primary Lead Imports

By Marilyn Biviano and Judith Owens

UNITED STATES DEPARTMENT OF THE INTERIOR

Bruce Babbitt, Secretary

BUREAU OF MINES

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

g	gram	mt/yr	metric ton per year
g/m	gram per meter	μg/m^3	microgram per cubic meter
kg	kilogram	μg/100g	microgram per 100 gram
lb	pound	ppm	part per million
mg/l	milligram per liter		
Mmt	million metric ton		

THE MINERALS RELATED IMPLICATIONS OF A DIRECT TAX ON U.S. PRIMARY LEAD PRODUCTION AND PRIMARY LEAD IMPORTS

By Marilyn Biviano[1] and Judith Owens[2]

ABSTRACT

The U.S. Environmental Protection Agency (EPA) and the U.S. Congress are considering the use of a tax on primary lead to reduce U.S. lead consumption, to generate revenues for a lead abatement program, and/or to encourage the secondary recovery and recycling of lead. The results of this study suggest a primary lead tax policy will be ineffective in achieving these objectives.

This study assesses the economic impacts of a tax on primary lead and lead imports. Increased secondary supplies, largely from imports, are expected to displace domestic primary lead supplies that become uneconomic because of the tax and no substantial increase in lead battery recycling is estimated to result from the tax. A primary lead tax of $0.80 per pound would eliminate domestic primary lead production as well as reduce domestic source production of: zinc by 87%, silver by 16%, bismuth by 89%, cadmium by 85%, and would eliminate the most significant domestic source of germanium and indium presently available.

EXECUTIVE SUMMARY

BACKGROUND AND SCOPE

Because lead can be hazardous to human health and the environment, the EPA and the U.S. Congress are presently considering several approaches aimed at reducing the amount of lead in the environment and society's exposure to lead. One approach is to tax domestic primary lead production[3] or consumption. The objectives of such a tax may include: (1) reducing human exposure to lead by discouraging production of "new" lead, (2) encouraging secondary recovery activities by making primary lead more costly to produce than secondary lead, and (3) raising revenues for lead abatement or other Government programs.

The EPA has recently been investigating the merits of a primary lead production tax, i.e., a "pollution prevention fee" on primary lead production. A bill has been introduced in Congress, H.R. 2922, "Lead-Based Paint Hazard Abatement Act," which would impose a tax of $0.75 per pound on primary lead metal production and primary lead imports. This tax is equivalent to about twice the average 1990 lead price. In addition, under H.R. 2922, a tax of $0.37 per pound on secondary lead metal production and imports would be levied; exports of lead ores and concentrates and lead scrap would be exempt from the tax; and tax revenues would be used to provide assistance to cities and States for lead abatement projects, primarily the removal of lead-based paint on older housing units.

To assist the Congress and the EPA in their decisionmaking, a study was initiated by the Bureau of Mines which assesses the minerals related implications of a tax on U.S. primary lead production and primary lead imports.[4] This investigation analyzes the impacts of the tax

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[3]Primary production refers to lead metal extracted from ores. Secondary production refers to lead recovered from lead scrap, mainly spent lead batteries.

[4]The analysis assumes that the tax will be identical for domestic primary lead production; imports of primary lead, including primary lead metal; contained lead in imported lead concentrates; and primary lead contained in imported manufactured products. This study does not analyze the impacts of any specific bill or proposal. However, this analysis does shed light on the effectiveness of a primary lead tax in achieving planned policy objectives as well as the economic implications of a specific tax.

on: (1) domestic primary lead production, (2) domestic lead coproduct and byproduct production (including bismuth, cadmium, germanium, indium, silver, and zinc production), (3) domestic secondary lead production, (4) lead imports, (5) domestic lead recycling activity, and (6) the U.S. lead price.

STUDY FINDINGS

The study found within 1 to 3 years following the implementation of a tax on domestic primary lead production the following long-term impacts on domestic primary and secondary lead production, lead coproduct and byproduct production, lead imports, and domestic lead recycling activity would take place.

Domestic Primary Lead and Primary Lead Coproduct and Byproduct Production

A quantitative analysis based on the application of the Bureau of Mines Supply Availability Model (SAM) has been conducted to determine the impacts on domestic primary lead and primary lead coproduct and byproduct production from domestic source material for a range of taxes.[5] The impact on the domestic production of lead, bismuth, cadmium, germanium, indium, silver, and zinc has been estimated for a tax on primary lead production ranging from $0.04 per pound (10% of the 1990 average lead price) to $1.25 per pound (approximately 300% of the average 1990 lead price).

An estimated 21% of domestic primary lead production would become uneconomic with a primary lead tax of $0.04 per pound, which is equivalent to 10% of the average 1990 lead price. A tax of $0.10 per pound, which is equivalent to 25% of the 1990 lead price, would reduce economic domestic primary lead production by 77%. A tax of $0.80 per pound would eliminate domestic primary lead production entirely (figure 1 and table 1).

Reduced domestic primary lead production will also result in reduced domestic source production of several other important minerals that are lead coproducts or byproducts of lead production.

Relative to 1989 domestic production, the mineral properties under study would produce annually over the next 10 years an estimated:

- 99% of domestic primary lead production
- 125% of (domestic) primary zinc production
- 91% of bismuth production
- 130% of cadmium production
- 16% of silver mine production

Table 1.—Estimated impact on domestic primary lead and lead coproduct production[1] resulting from a primary lead tax

(Percent change in production)

Tax rate per pound

	$0.04	$0.10	$0.20	$0.40	$0.80	$1.25
Lead	−21	−77	−81	−84	−99	−99
Zinc[2]	−4	−20	−20	−30	−87	−87
Cadmium[2]	−4	−18	−18	−28	−85	−85
Bismuth[2]	−0	−49	−49	−89	−89	−89
Silver[2]	−1	−4	−4	−6	−16	−16

[1]The analysis includes most major domestic lead-producing properties. Relative to 1989 production, the study properties will produce 99% of (domestic primary) lead production, 125% of zinc production, 91% of bismuth production, 130% of cadmium production, and 16% of domestic silver production. The mineral production impact estimated to result from a specific tax is the percent change from the base production of the properties included in the analysis. The larger of the two annual production numbers, 1989 production or the total study estimated production, was used as the base for calculating the percentage decline in production due to the tax. For example, the 5% decline in silver production from the properties analyzed, estimated to result from a 10% tax on primary lead, is equivalent to a 5% X 16% = 1% decrease in total domestic silver production. The properties also provide significant quantities of indium and germanium, which are refined outside of the United States.

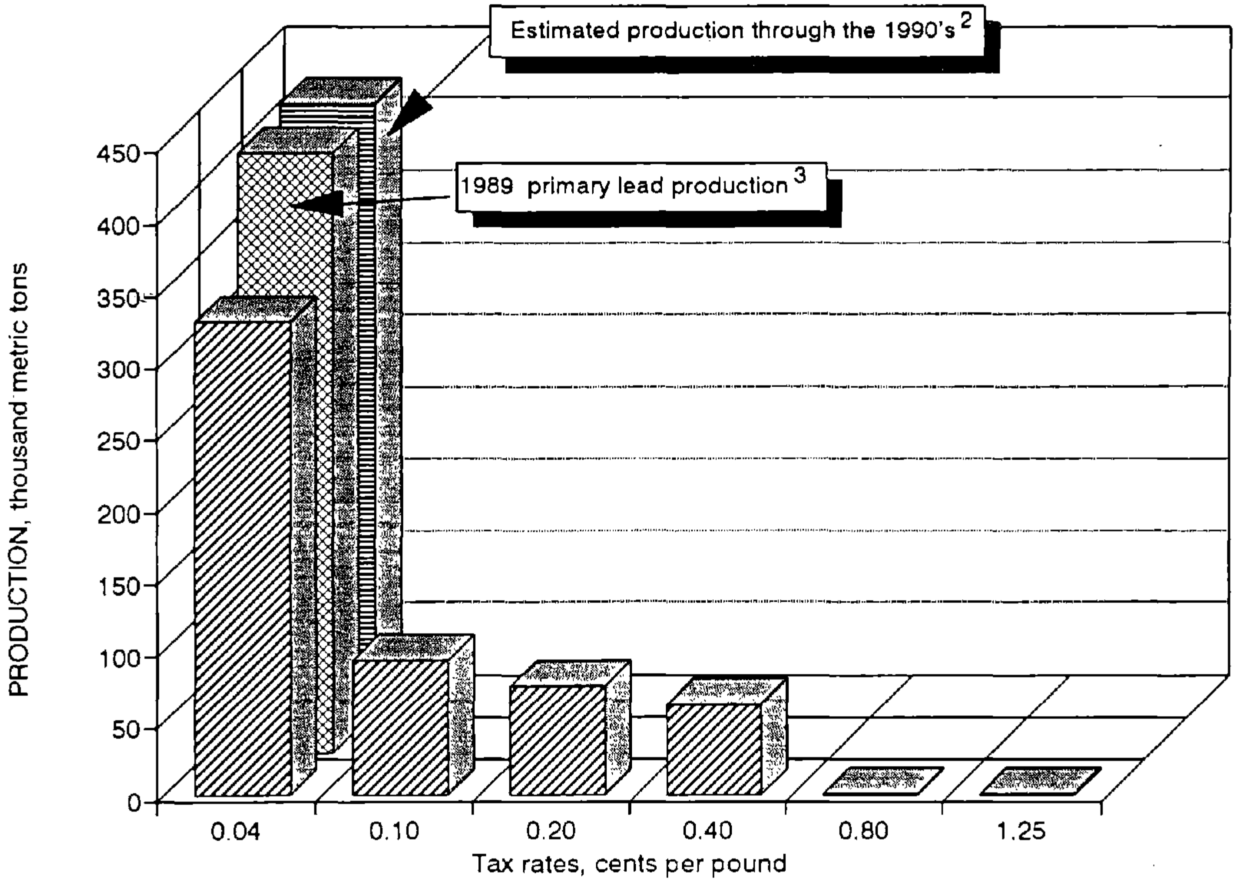
[2]The following byproduct price assumptions are made: $0.65/lb zinc, $0.85/lb copper, $5.50/troy ounce of silver, and $400/troy ounce of gold.

These lead-producing properties will also provide the only significant domestic source of germanium and indium presently available.

A primary lead tax of $0.10 per pound (equivalent to 25% of the 1990 lead price), which reduces U.S. primary lead production by 77%, also reduces domestic source production of zinc by 20%, bismuth by 49%, cadmium by 18%, and silver by 4%. A tax of $0.80 per pound, which reduces the U.S. primary lead production by 99%, also

[5]The Bureau of Mines Supply Availability Model (SAM) is a cash-flow analytical system, which was used to provide economic analyses of mineral properties. Domestic primary lead production, estimated for each tax rate, includes production from domestic properties with a discounted cash-flow of zero or higher and for which the estimated annual production costs are no higher than $0.31/lb, which is the estimated long-term market price for lead (an average of the 1980–90 estimated U.S. lead market price (LME price + $0.04/lb)). Other average estimated long-term market prices which were used to estimate the lead production cost for each property include: $0.65/lb zinc, $0.85/lb copper, $5.50/troy ounce silver, and $400/troy ounce gold. (Current prices are considerably below the historic averages. If current prices were used, the estimated impacts of a tax would be greater.)

The impacts on domestic bismuth, cadmium, germanium, and indium production are based on the SAM lead analysis and on expert judgment regarding processing recovery rates for each byproduct from each lead-producing property.



1 Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

2 Includes estimated lead production from one new operation.

3 Source: 1991 Mineral Commodity Summaries.

Figure 1.—Annual domestic production[1] of primary lead under alternative primary lead tax rates.

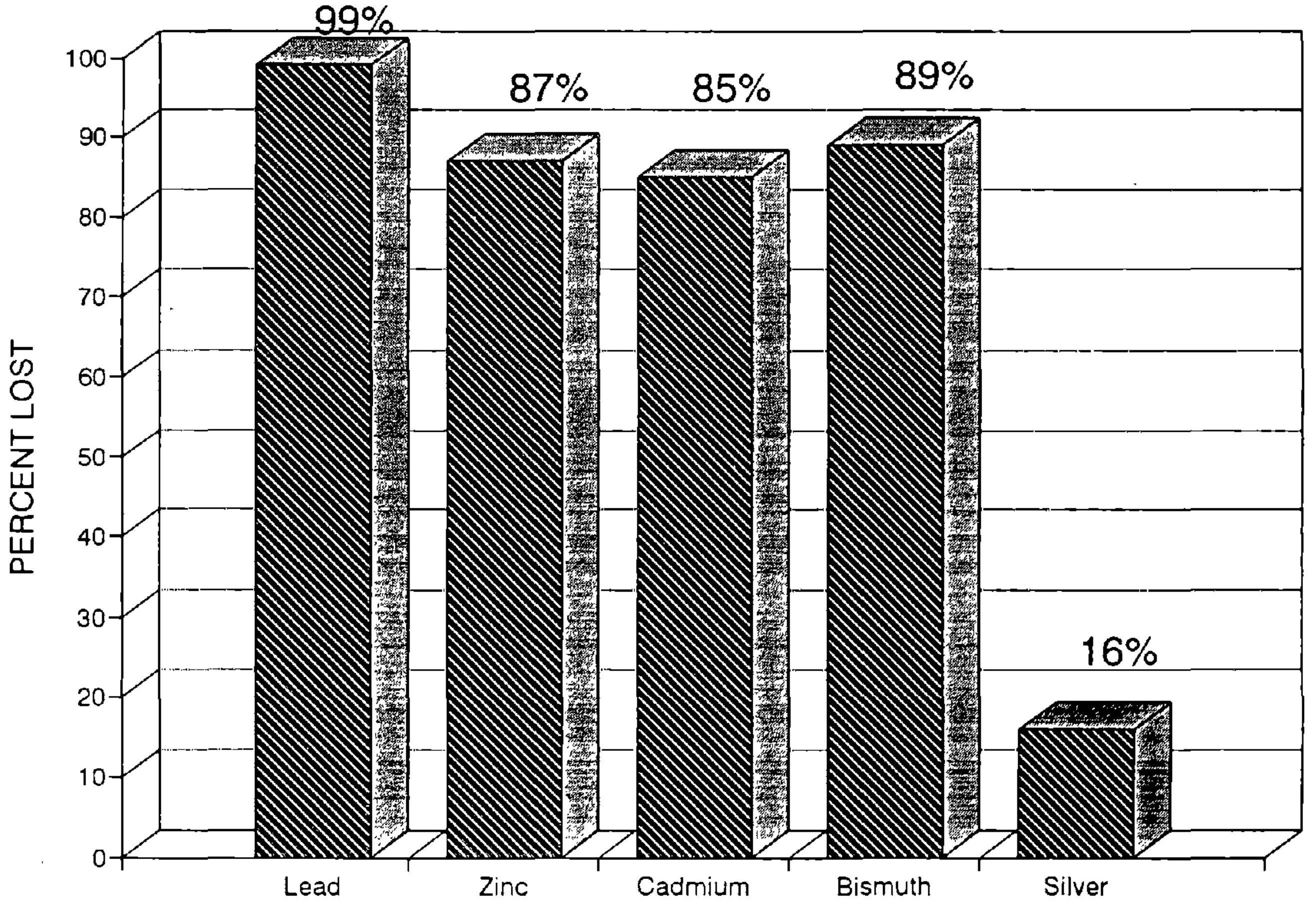
reduces domestic source production of: zinc by 87%, bismuth by 89%, cadmium by 85%, silver by 16% (figure 2), and would eliminate the most significant domestic source of germanium and indium available in the near future.

U.S. Secondary Imports and Production

Increased secondary lead supplies, consisting largely of imports of secondary metal, will offset any decline in domestic primary lead production activity that becomes uncompetitive because of the higher costs associated with a primary lead tax on the domestic producer.

Initially, because there are no economic substitutes for lead in its major applications, the tax could be passed on to manufacturers in the form of higher lead costs and, in turn, to consumers in the form of higher priced lead-containing products, primarily lead-acid batteries used in automobiles. A tax on domestic primary lead production and primary lead imports would, in the short run, result in the creation of two lead markets—a U.S. lead market and a rest-of-world lead market with the new U.S. lead price higher than the rest-of-world lead price by an amount less than or equal to the tax rate. With an increase in the domestic lead price by the amount of the tax, secondary lead supplies, secondary lead imports, and domestic secondary production, all of which remain untaxed, will have a significant competitive advantage, and will begin to increase.

The premium U.S. lead price will then fall as secondary lead imports and domestic secondary production increases begin to displace domestic primary lead supplies, which



[1] Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

Figure 2.—Estimated loss of domestic production[1] of lead, zinc, cadmium, bismuth, and silver under a primary lead tax of $0.80/pound.

remain taxed and which have become uncompetitive because of the higher costs associated with the tax. Secondary supplies, primarily imports of secondary metal, can be expected in the longer run to offset any decline in domestic primary lead production which has become uncompetitive.

U.S. Imports of Primary Lead

Imports of primary lead supplies, in addition to imports of secondary lead, may also displace domestic primary supply because enforcement of a tax on imports of primary lead and primary lead contained in products will be difficult, impracticable, and expensive to administer. Outside of the United States, secondary lead is, in some places, smelted with primary lead resulting in an output that is a mix of primary and secondary lead. To ensure that primary lead, as metal or contained in manufactured products, is not imported as secondary lead, laboratory testing would be required. Even then, the results of such testing may be inconclusive as to whether the lead is primary or secondary lead. If the tax on primary lead imports cannot be successfully enforced, domestic primary lead supplies will be replaced by imported primary lead (and imported manufactured products containing primary lead) as well as by imports of secondary lead and lead scrap. Further, because lead production activities are so closely tied to battery manufacturing, a primary lead tax could also reduce the U.S. battery manufacturing competitive position.

Domestic Recycling Activity

Little or no increase in domestic recycling activity will take place. Arbitrage[6] will eventually reduce or eliminate the competitive advantage for domestic secondary producers created by the U.S. tax on primary lead production and imports. The maximum U.S. lead price premium that could remain in the long run will be equal to the costs of importing secondary lead and lead scrap,[7] estimated at $0.00 to $0.05 per pound. This maximum price premium would not provide sufficient economic incentive to affect the small amount of vehicular batteries that are not being recycled domestically, less than 5% in 1989, nor provide incentives to develop a collection and haulback system that would promote the recycling of small lead-acid batteries, which are used in large flashlights, video recorders, and household tools.

[6]Arbitrage is the process of buying a commodity in one market and selling it at the same time in another market in order to take advantage of the price differential. If the U.S./rest-of-world lead price differential is more than the costs of importing (i.e., transportation and handling) untaxed secondary lead, and there are sufficient alternative sources of lead, foreign secondary producers will find it to their advantage to export their secondary production to the United States. While foreign producers are acting independently in their own best interest, the total effect of their efforts will be to reduce or eliminate the U.S. versus rest-of-world lead price differential.

[7]Includes transportation, insurance, and tariff costs.

Domestic Secondary Lead Processing Capacity

The higher U.S. price for lead in the short run after the tax is imposed will result in increased profits for the untaxed domestic secondary industry. If the higher lead price and the resulting increased secondary industry profits are sustained for 1 or more years, expansion of the secondary industry can be expected and overexpansion may result, i.e., for a limited supply of lead scrap (secondary feedstock). In the long run, an overexpansion of secondary capacity, accompanied by a falling lead price would result in underutilization of secondary capacity, poor economic health, and an eventual decline in capacity. This cyclical behavior occurred during the 1980's and is endemic to metal market behavior.

ACKNOWLEDGMENTS

This analysis was greatly assisted by the cooperative efforts of the specialists in the Division of Commodities, and the Branch of Minerals Availability, the Division of Policy Analysis of the U.S. Bureau of Mines. William Woodbury, the lead specialist at the Bureau of Mines, in particular provided expertise, data, and review throughout the project. Catherine Kilgore, supervisory minerals specialist, provided production cost estimates, which were essential in the analysis, using the Minerals Availability Program's Supply Availability Model. Russell Foster, physical scientist, provided expertise and assistance in the analysis of lead coproducts and byproducts. James Jolly, Thomas Llewellyn, Stephen Jasinski, and Robert Reese provided data and expertise on zinc, cadmium, silver, bismuth, indium, and germanium mineral markets. Substantive review was provided by several industry sources. In particular, David Cook, Lake Engineering Inc., provided substantial assistance and expertise in the lead market assessment. Stan Miller, Chief, Office of Special Projects, provided support for the project and critical review and editing of the study report.

INTRODUCTION

Lead is an important industrial metal[8] that has important physical properties and uses. Lead resists corrosion, is a poor conductor of electricity, has a low melting point, and shapes easily. The largest application for lead is in lead-acid batteries, which account for about 80% of domestic lead consumption. Lead-acid batteries include vehicle, industrial, and the small consumer batteries. (Lead-acid consumer batteries are typically size D or larger but weigh less than 25 pounds and are used in large flashlights, large toys, video recorders, and household tools.) Presently, there are no acceptable substitutes for lead in most lead-acid battery applications.[9]

[8]Lead is also designated a strategic and critical material. A strategic and critical material is defined under Section 12(1) of the Strategic and Critical Materials Stockpiling Act as amended (P.L. 101–189) as a material that would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency and for which there are insufficient domestic sources of supply.

[9]ICF Incorporated, "Use and Substitutes Analysis of Lead and Cadmium Products in Municipal Solid Waste," Prepared for the U.S. Environmental Protection Agency (Contract No. 68-D8-0116), Feb. 1, 1990, pp. xiii, 80–82.

Although lead is an important industrial metal, it is toxic under certain conditions and there are serious environmental concerns associated with primary and secondary lead production activities, discarding and disposing of lead products such as batteries, and from exposure to lead products such as lead-based paints. These concerns have been reflected in the regulations under the Clean Air Act, the Clean Water Act, the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit, OSHA's Medical Removal Program, the Resource Conservation and Recovery Act, and the Solid Waste Disposal Act.

Because of lead's toxicity when ingested, the use of lead in ceramic glazes, frits, shot for hunting migratory waterfowl, interior and exterior residential paints, and pipes and solders in municipal water systems has significantly declined or has been eliminated.

More recently, the disposal of products containing lead and the health effects of low levels of lead exposure have become of increasing concern. As a mechanism to reduce disposal of lead-acid batteries, the EPA initiated a regulatory negotiation for a lead-acid battery recycling rule.[10] The committee's purpose was to negotiate issues which would lead to lead-acid battery recycling regulation under section 6 of the Toxic Substances Control Act (TSCA). The regulatory negotiation came to an abrupt end after 10 months, however, when EPA officials announced that the costs associated with a Federal rule would outweigh any benefits it might promote.

[10]Federal Register 52884-52886, Dec. 24, 1990.

Several approaches aimed at reducing the amount of lead in the environment and society's exposure to lead are presently being considered by the U.S. Congress. Five bills have been introduced during the current session of Congress and 10 bills were introduced in the last session of Congress to this end (table 2 and appendix). These bills, introduced as amendments to TSCA, the Solid Waste Disposal Act, the Internal Revenue Code of 1986, and the Public Health Service Act, were designed to encourage recycling, and/or to reduce the level of lead in the environment as well as to generate revenues.

The five bills that were introduced in the current session are H.R. 2922—"Lead-Based Paint Hazard Abatement Act,"S. 391 and H.R. 1750—"Lead Exposure Reduction Act of 1991," and H.R. 870 and S.398—"Lead Battery Recycling Incentives Act." H.R. 2922, "The Lead-Based Paint Hazard Abatement Act," would impose a tax on lead of $0.75 per pound on primary lead—equivalent to about 200% of the average 1990 lead price as well as a $0.37 per pound tax on secondary lead, exempting exports from the tax. Under H.R. 2922, the tax revenues would be used to provide assistance to cities and States for lead abatement projects, primarily the removal of lead-based paint on older inner city dwellings.

The "Lead Exposure Reduction Act of 1991," S. 391, and the companion bill, H.R. 1750, set a maximum lead content for certain products, including paint, pesticides, plumbing fittings and fixtures, toys, gasoline, and food cans, and call for health studies on lead exposure and the development of lead exposure abatement programs.

Table 2.—Proposed Federal legislation directed at lead introduced by the 102d Congress

(as of September 23, 1991)

Bill	Summary
H.R. 2922—Lead-Based Paint Hazard Abatement Act	Establishes an excise tax of $0.75 per pound on primary lead metal production; $0.37 per pound tax on secondary lead metal production. Tax revenues would be used for lead-based paint abatement programs in States and specific urban areas and/or cities.
S. 391—Lead Exposure Reduction Act of 1991	Prohibits the importing, manufacturing, processing, or distribution of certain products containing more than a specified percentage of lead. A maximum lead content (dry weight) is set for: paint (0.06%); plumbing fittings and fixtures (2%); pesticides (0.1%); and toys and recreational game pieces (0.1%).
	Prohibits the landfilling and/or incineration of lead-acid batteries.
H.R. 1750—Lead Exposure Reduction Act of 1991	Companion bill to S. 391.
H.R. 870—Lead Battery Recycling Incentives Act	Requires producers and/or importers of lead-acid batteries to use a minimum amount of recycled lead in the production of such batteries.
S. 398—Lead Battery Recycling Incentives Act	Companion bill to H.R. 870.

The "Lead Battery Recycling Incentives Act," H.R. 870, and the companion bill, S. 398, require lead-acid battery manufacturers and importers to use a minimum proportion of recycled lead in the batteries. The bill also provides for "recycling credits," which are earned by using a greater proportion of recycled (secondary) lead than is required under the bill, to be used to meet the mandatory secondary content requirements.

The EPA is responsible for controlling lead pollution through a number of regulatory programs managed by different EPA offices including the Office of Drinking Water, the Office of Water Regulations and Standards, the Office of Solid Waste, the Office of Pesticide Programs, the Office of Toxic Substances, and the Office of Air Quality Planning and Standards.

EPA has developed a strategy to reduce lead exposures to the fullest extent possible, with particular emphasis on reducing the risk to children. This strategy incorporates the program efforts of all of the EPA offices involved in controlling lead exposure.[11] In the lead strategy document, EPA lists three major sources of lead exposure: (1) lead-based paint, (2) urban soil and dust (contaminated in the past by lead-based paint and the lead in gasoline), and (3) drinking water (due mainly to lead solder joining water pipes in housing, the past use of lead service lines to connect homes to public water supplies, and the continuing use of lead in brass plumbing fixtures). Other sources of lead emissions of concern to EPA include stationary point sources (lead smelters), sewage sludge disposal, Superfund National Priority List sites, municipal waste combustors, continued use of lead in products or for purposes that could result in high exposure (e.g., solder used to join plumbing pipes and industrial paint), and mining sites (residual mine waste).

In addition to the extensive regulatory control approach currently undertaken to reduce lead exposure under the EPA programs listed above, the EPA has cited several other courses of action that it may take including market-based incentives and nontraditional control mechanisms, such as a tax on primary lead production. According to EPA, the tax could be levied through provisions under the TSCA. As indicated earlier, however, the EPA reported at the final meeting of the lead-acid battery regulatory negotiation committee, which was held in September 1991, that the costs of a Federal program to regulate battery recycling could not be justified under the TSCA risk-benefit provisions.

Given the attention that a primary lead production tax has received, this analysis has been undertaken to provide decisionmakers with the minerals related impacts resulting from the implementation of this option. The analysis estimates the short- and long-term impacts resulting from a primary lead production tax on the U.S. lead price, primary and primary lead coproduct and byproduct production (including zinc, silver, bismuth, cadmium, germanium, and indium), domestic secondary lead production, lead imports, and domestic lead recycling activity.

[11] "U.S. Environmental Protection Agency Strategy for Reducing Lead Exposures," Feb. 1991. Available through request from the EPA.

THE DOMESTIC LEAD MARKET

U.S. DEMAND

From 1980 through 1990 domestic industrial consumption of lead metal ranged from 1.0 to 1.3 million metric tons (figure 3). Lead consumption increased, on average, by 1.4% annually during that period.

The major application for lead is in the manufacture of lead-acid storage batteries, accounting for about 80% of domestic consumption. The demand for lead in the production of lead-acid storage batteries has grown significantly since 1980. In 1980, 640,000 metric tons of lead was used to produce batteries. In 1990, over 1,000,000 metric tons of lead was used to produce batteries—80% of domestic consumption.

Lead-acid batteries are used in electrical systems that depend on these batteries for startup, such as vehicles, ships, and aircraft and for uninterrupted power supply (UPS) systems needed for hospitals or large computer and telecommunication networks. Lead-acid batteries are also an essential source of standby electrical energy for emergency lighting and telephone or other communications systems.

In 1990, other lead-consuming sectors include ammunition (4%), chemicals (4%), and electrical components and equipment (2%). As a result of substitution, environmental concerns, or by fiat through environmental regulations, the use of lead has declined or been eliminated from gasoline, ceramic glazes, enamel frits, shot for hunting migratory waterfowl, in interior and exterior residential paints, and pipes and solders in municipal water systems.

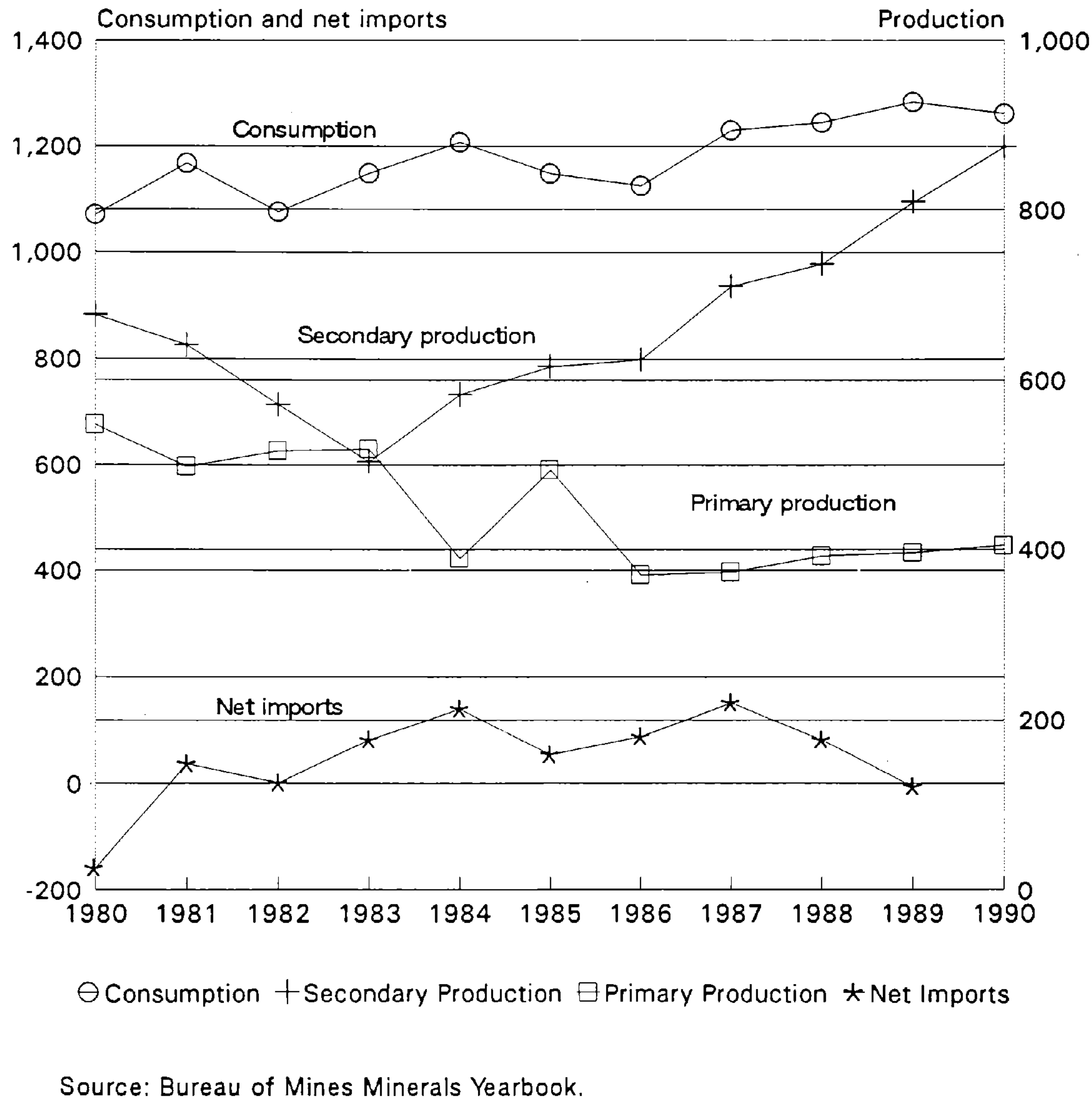


Figure 3.—U.S. lead consumption and supply trends (thousand metric tons).

Substitution

An investigation of substitutes by use for lead and cadmium was recently completed for EPA.[12]

The study focuses on lead- and cadmium-containing products that are disposed in municipal solid waste (MSW), technically feasible substitutes for lead and cadmium in

[12]ICF Incorporated, "Use and Substitutes Analysis for Lead and Cadmium Products in Municipal Solid Waste," (EPA Contract No. 68-D8-0116), Feb. 1, 1990, p. 80.

The ICF analysis of substitutes for lead in lead-acid batteries is based on another source: J.G. Palmer, Sept. 1988, "A Cleaner Environment: Removing the Barriers to Lead-Acid Battery Recycling." Written in Collaboration with M.L. Sappington, P.E., President, Lake Engineering, Inc., Atlanta, GA major applications, and the health concerns associated with the substitutes.[13] According to the study, there are no acceptable substitutes for lead in lead-acid starting, lighting, and ignition batteries, which are used in virtually all motorized vehicles.

Nickel-cadmium, nickel-zinc, nickel-iron, and silver-zinc batteries were assessed as alternatives to lead-acid batteries in the study. Nickel-cadmium batteries are more toxic for disposal, and 5 to 10 times more costly than an equivalent sized lead-acid battery. The power density of nickel-cadmium batteries is 20% to 30% lower than lead-acid batteries so that the cost of the unit of delivered power is about 7 to 13 times more expensive for nickel-cadmium batteries, assuming equal service lives. Nickel-zinc batteries have a lower power density than lead-acid batteries, a limited lifetime (50 to 200 recharging cycles), and relatively poor reliability at this time. Nickel-zinc batteries are two to three times more costly than an equivalent powered lead-acid battery.[14]

The power density[15] of nickel-iron batteries is only one-fourth to one-third that of lead-acid batteries, and they have very poor low-temperature performance and charge retention.[16]

Silver-zinc batteries are very expensive—20 to 100 times the cost of an equivalent sized lead-acid battery, have a limited lifetime (approximately 250 cycles), and experience decreased performance at low temperatures.

The other lead-containing applications assessed for substitutes in the EPA-commissioned study include glass and ceramic products, solder, plastics, and pigments. This substitution analysis is detailed and includes assessment of the technical performance of the substitute in very specific applications.[17] In most of the remaining nonbattery applications, there are substitutes or potential substitutes. However, the substitutes may not perform as well; the life span of the product may be reduced; and there may be direct or indirect health hazards associated with available substitutes.

[13]The health concerns assessment was based on the assessment, "Preliminary Relative Risk Evaluation of Lead and Cadmium Substitutes," prepared by the Chemical Screening Branch, Existing Chemical Assessment Division, EPA, July 28, 1989.

[14]Work cited in footnote 12.

[15]The power density of a battery is the amount of power the battery can produce relative to its weight.

[16]Work cited in footnote 12.

[17]For example, the analysis of lead-containing substitutes in glass includes an assessment of neck, funnel, and faceplate glass in televisions; X-ray shielding, neon and fluorescent tubing, light bulb, and ophthalmic glass in leaded glass; optical and ophthalmic glass; and lead crystalware.

U.S. SUPPLY

Domestic primary production of lead provided a declining portion of domestic supply from 1980-90. In 1980, primary production provided 51% of domestic supply; in 1990, primary production provided 30%. Domestic secondary production, i.e., recovery of lead from scrapped batteries and other manufactured products, provided the more significant and increasing portion of domestic supply from 1980 through 1990. Secondary production supplied 44% of domestic supply in 1980 and 70% in 1990. A major factor contributing to the increase in the domestic secondary share of supply during the 1980's was the phaseout of leaded gasoline, a nonrecyclable use of lead. Net imports of lead metal, concentrates, and scrap satisfied 0% to 12% of industrial demand during this period. Canada and Mexico, together, supplied about 80% of the imported lead.

Lead is also embodied in manufactured products that are imported, including automobiles (batteries) and automobile replacement batteries, TV's, computer video display equipment, electronics, and glassware. Lead contained in imported manufactured products is an important component of total domestic lead supply and cannot be ignored in policies aimed at curbing domestic lead consumption. The Bureau estimates that the United States annually imports 120,000 metric tons of lead, which is contained in manufactured products.[18] This is equivalent to 10% of domestic industrial demand for lead metal. In total, imported lead metal and lead contained in manufactured products that are imported provided an estimated 18% to 25% of domestic lead supply. The U.S. 1989 supply-demand relationship, including lead imports in manufactured products, is depicted in figure 4.

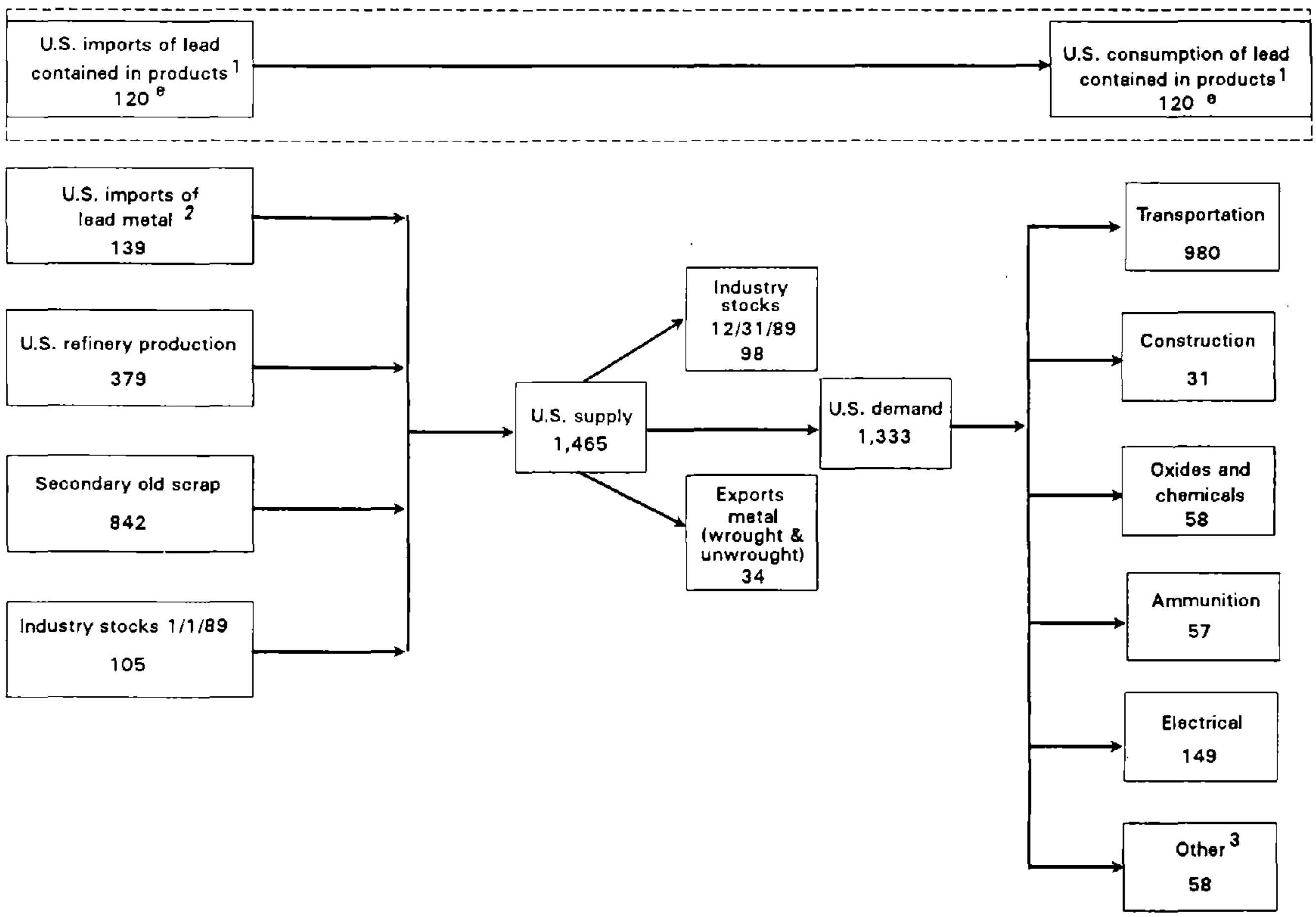
U.S. Primary Lead Production

U.S. primary lead production totaled 396 kmt in 1989, providing 33% of total domestic refined lead output (primary plus secondary). As discussed above, primary production has provided a declining share of domestic lead production. Since 1980, domestic primary lead production has declined on average by .6% per year.

Although lead is mined in 11 States: Alaska, Arizona, Colorado, Idaho, Illinois, Missouri, Montana, New Mexico, New York, South Dakota, and Tennessee, 89% of total primary lead production took place in Missouri in 1989.

Domestic primary lead production costs vary considerably by operation. In most operations, the profitability of lead production depends on the price of zinc or silver. Other byproduct revenues may also affect profitability of domestic primary lead production.

[18]William Woodbury, lead specialist, U.S. Bureau of Mines. Private communication, Oct. 1990.



[e] Estimated. Estimated by William Woodbury, U.S. Bureau of Mines lead specialist.

[1] Includes the following: car batteries (50%), TV's, separate battery units, VDT's glassware, etc.

[2] Includes the following: lead in concentrates, metal, wrought and unwrought, and refinery production from foreign ores. Major import sources (total lead content) were from the following countries during the period of 1985-88: Canada, 61%; Mexico, 22%; and other, 17%.

[3] Includes gasoline additives.

Figure 4.—Lead supply and demand relationships—1989 (thousand metric tons of lead content).

Secondary Lead Production

Secondary lead production is a major source of lead in the United States and worldwide. In 1989, lead production from secondary refineries accounted for 45% of total world lead production. In the United States, secondary refiners produced about 67% of the refined lead output from all sources. U.S. secondary production provided from 43% to 69% of domestic consumption requirements from 1980-90. Since 1983, annual domestic secondary refinery production increased on average by 6%, outpacing domestic consumption, which increased by about 1% annually. Again, the phaseout of lead in gasoline increased the relative available recyclable lead feedstock.

Secondary Lead Production Capacity

Total annual secondary capacity for refined lead and lead alloys at yearend 1989 was estimated by the Bureau to be 930,000 metric tons. This capacity was owned by 42 companies and consisted of 50 plants, with individual capacities ranging from less than 1,000 metric tons per year to 120,000 metric tons per year. The 10 largest companies operated 18 plants, representing 89% of the production capacity.

The quantity of secondary capacity shows cyclical variation, with expansion and overcapacity following a period of high lead prices and a capacity contraction following a low-lead-price trend. Following the high lead prices of the late 1970's, domestic secondary capacity expanded from 800,000 annual metric tons in 1976 to 1.3 million annual metric tons by 1981. At this point, secondary capacity exceeded the high domestic secondary production of the late 1970's by about 50% and total domestic lead consumption (primary plus secondary) by 133,000 metric tons in 1981. Lead price declined by 50% from 1979 to 1985. Secondary capacity began falling in 1981. By 1985, secondary capacity had declined by 33%. Since 1986, lead prices have increased significantly and secondary capacity has again grown substantially. At the end of 1990, there was more than 1 million metric tons of annual capacity and there was a reported shortage of scrap supply. If the secondary industry continues to expand capacity, overexpansion will again result. And, if the lead market price trends down again, secondary plant closures could be close behind.

Because the variation in domestic secondary capacity is highly correlated with lagged lead prices, a statistical analysis of this relationship was made. The same year, 1-year, 2-year, and 3-year lagged and moving average lead prices were correlated with secondary capacity over the 1981-90 period. The highest correlation and the most significant statistical relationship found was between secondary capacity and the 3-year lagged moving average lead price. Changes in secondary capacity and the 3-year lagged moving average of lead prices are almost perfectly correlated, an estimated 95% of the variation in capacity during the 1981-90 period was explained by the lagged average price of lead (r^2=.95). The relationship is illustrated in figure 5.

Secondary Lead Feedstock

Secondary lead is produced from old and, to a minor extent, new lead scrap. New scrap is generated in the process of refining, casting, or fabricating lead-containing materials. Old scrap comes from obsolete materials such as lead battery plates, drosses, and residues. In 1990, new scrap provided about 5% of the domestic lead (contained lead) scrap that was recovered. Recycled lead—secondary recovery of lead from old scrap—provided the remaining 95%.

U.S. secondary lead producers rely principally on spent automobile batteries for lead feedstock; 60 to 70 million automotive batteries are available for recycling annually. From 1980 to 1990, lead recovered from scrapped automotive batteries provided an increasingly larger share of total secondary lead feedstock, accounting for 71% to 85% of the lead recovered by secondary smelters.

The United States is a net exporter of scrap (figure 6). During the 1980-89 period, imports of scrap have ranged from less than 1,000 metric tons to 7,000 metric tons—providing less than 1% of domestic secondary feedstock. Lead scrap exports averaged 42,000 metric tons of (contained) lead from 1985-89, equivalent to 5% of 1989 domestic secondary production.

Lead-Acid Battery Recycling

The recycling of lead-acid batteries is the major source of feedstock for secondary refineries and for battery manufacturers. In 1990, 784 kmt of lead was recovered from spent batteries—85% of the total recycled lead. Since 1983, the lead recovered from batteries has been increasing steadily, and in 1990 was 90% higher than the amount recovered in 1983.

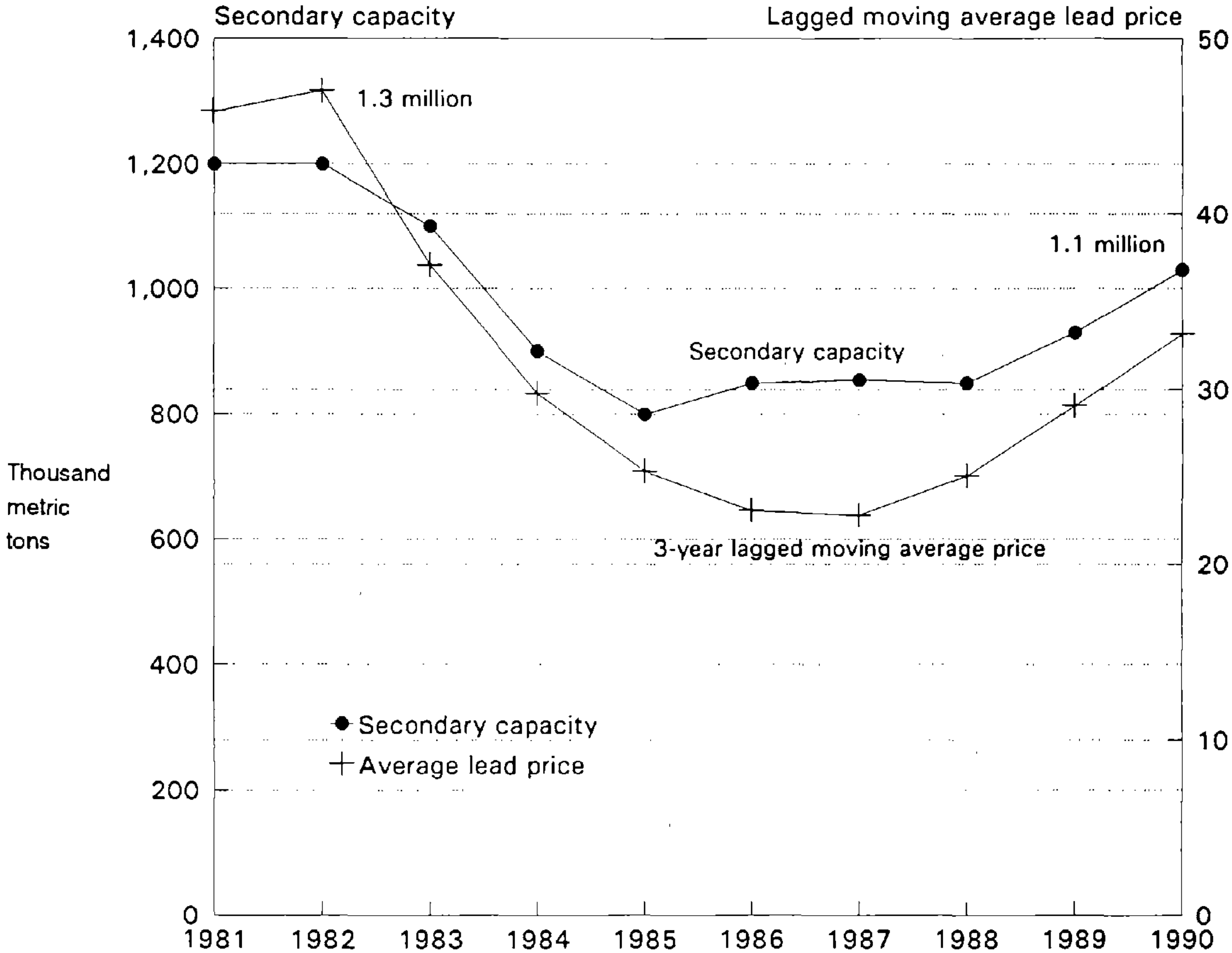
Lead-acid batteries include starting, lighting, and ignition (SLI); industrial; military; and consumer batteries.[19] The most significant category is SLI batteries, about two-thirds of total consumption, which are used in automobiles, trucks, and other vehicles as a source for starting, lighting, and ignition (SLI). In 1989, more than 91% of the lead available for recycling from domestic battery scrap was derived from this source. An estimated 8% of the lead available for recycling is from industrial batteries. Industrial batteries serve as a motive or stationary source of power or back up source of power. The remainder, an estimated 1%, is available from spent consumer batteries. However, there is no established recycling system for consumer batteries and they do not contribute to secondary supply.[20]

Battery recycling rates have increased annually since 1985. An estimated 95% of the lead in spent batteries (includes all lead-acid batteries) was recovered in 1989.[21] A statistical analysis was made to estimate the correlation

[19]Consumer batteries are storage batteries that weigh less than 25 pounds; are sealed, typically size D or larger; and are used in residential or commercial nonvehicular applications, e.g., large flashlights, large radios, tools, and large toys.

[20]Estimates of lead available for recycling in SLI, industrial and consumer batteries were derived from: Smith, Bucklin & Associates, Inc., "Battery Council International National Recycling Study," Apr. 1991, p. 12.

[21]Recycling rates are a measure of recycling activity. As with all rates, the measure is per unit of time. Thus, batteries that are retired and recycled in the same year add positively to the rate, batteries that are retired but not recycled lower the rate. If a battery is not recycled in the same year that it becomes obsolete, it does not necessarily mean that the battery will be disposed of improperly or that it will not be recycled.



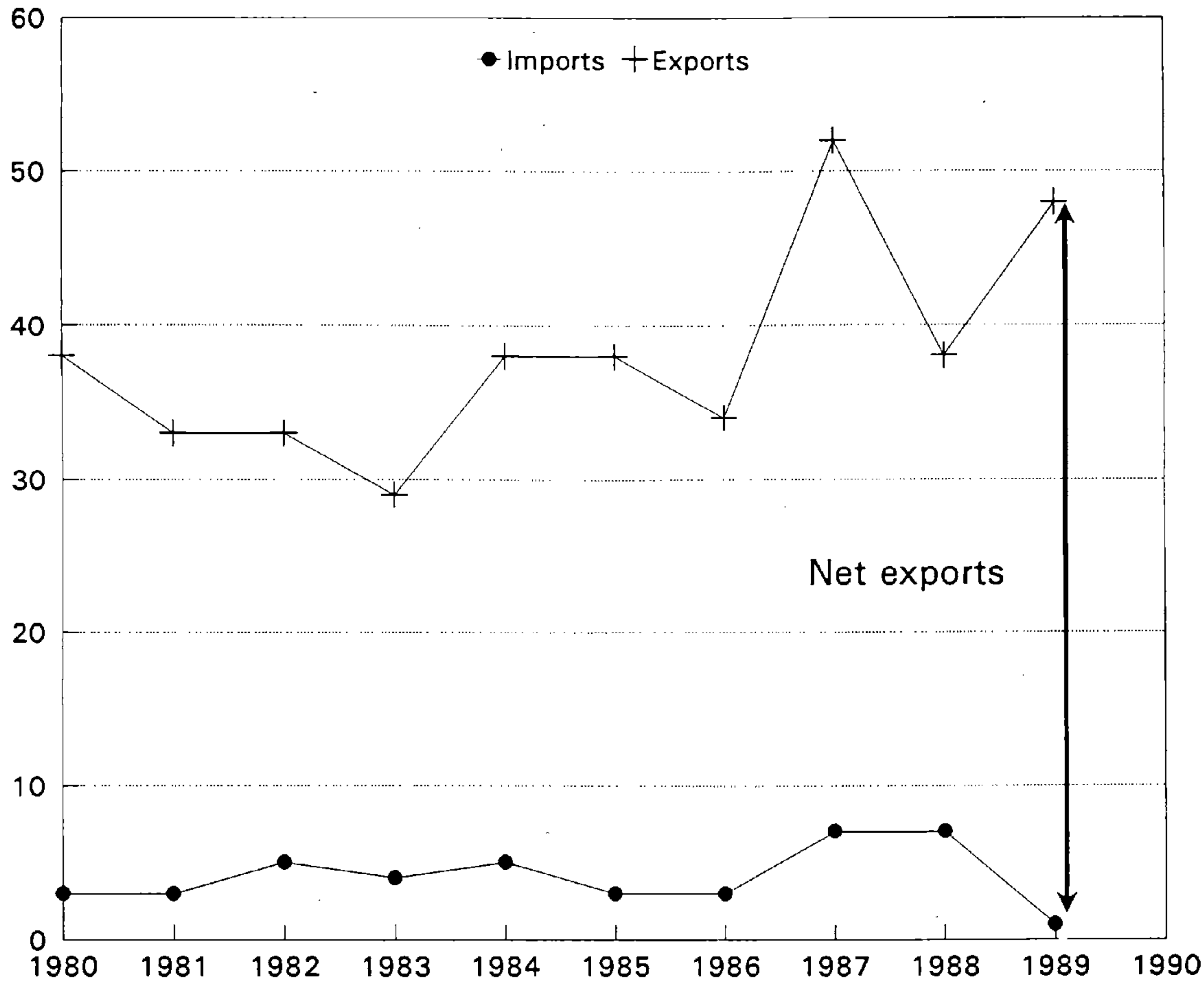
[1] LME lead price plus $0.04/lb.

Figure 5.—U.S. secondary capacity and the lead price,[1] a 3-year lagged moving average.

between recycling rates and the price for lead. Same year and 1-, 2-, and 3-year lagged and moving average prices were regressed on the estimated lead-acid battery recycling rates.[22] The highest correlation and the most significant statistical relationship was found between the recycling rate and the 1-year lagged lead price. The lagged price was estimated to explain 45% of the variation in the recycling rate (figure 7).

The price of lead may have been a more important influence in the first half of the 1980's. Since 1985, several other factors have also had a significant influence on the

[22]Lead battery recycling rates estimated by William Woodbury, lead specialist, U.S. Bureau of Mines.



Source: U.S. Bureau of Mines Minerals Yearbook.

Figure 6.—U.S. imports and exports of lead scrap (thousand metric tons).

continued increase in lead recycling rates including: (1) battery recycling laws enacted by 33 States in the past several years, (2) the development of a multipath, well-developed system to collect and recycle lead-acid batteries—except consumer (small) batteries—(some battery manufacturers are, in fact, dependent upon battery scrap for lead to produce batteries), (3) scrapped battery buy-back programs at some stores, which have encouraged consumers to turn in their old batteries, and (4) a growing public awareness of the potential environmental impacts that could result from batteries that are not recycled.

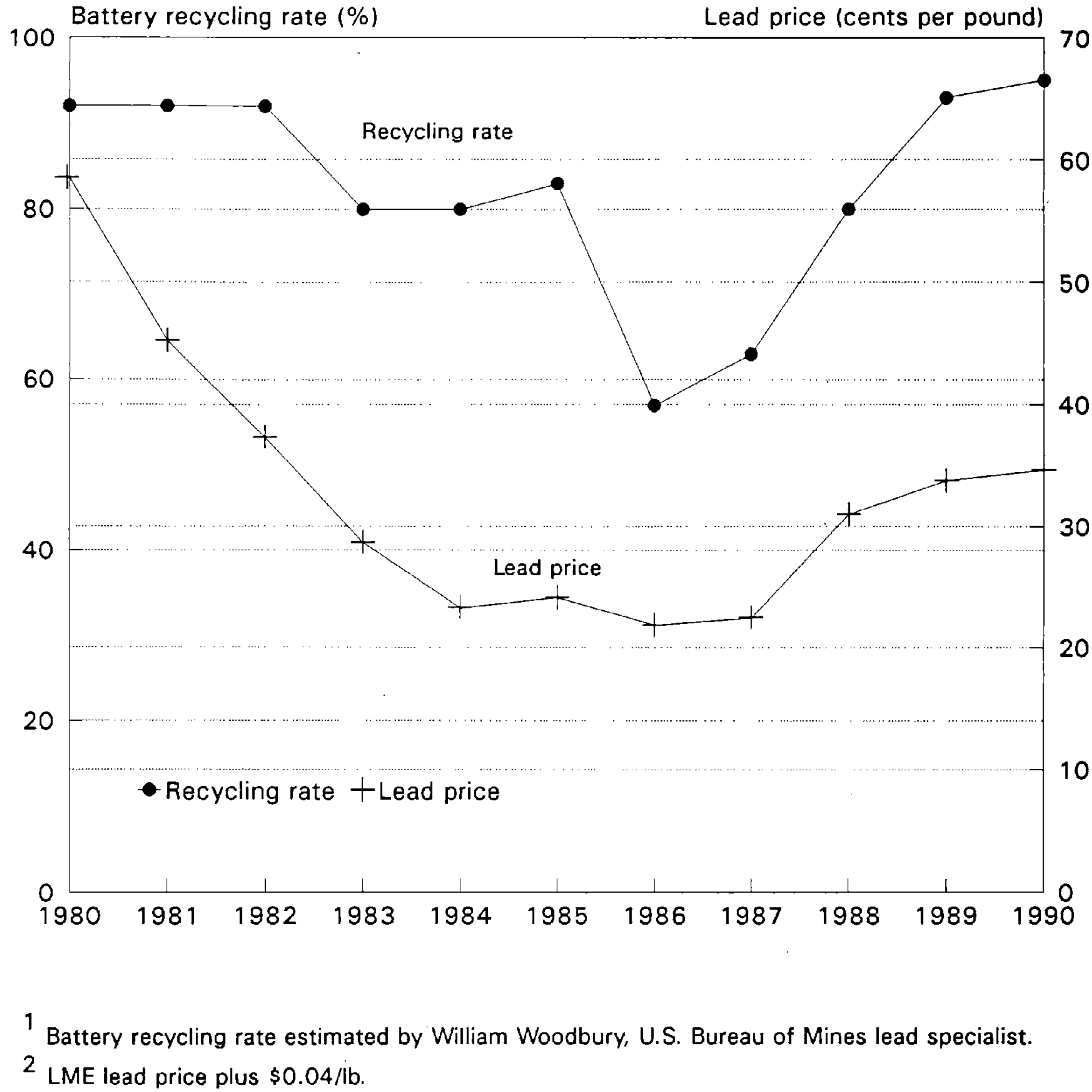
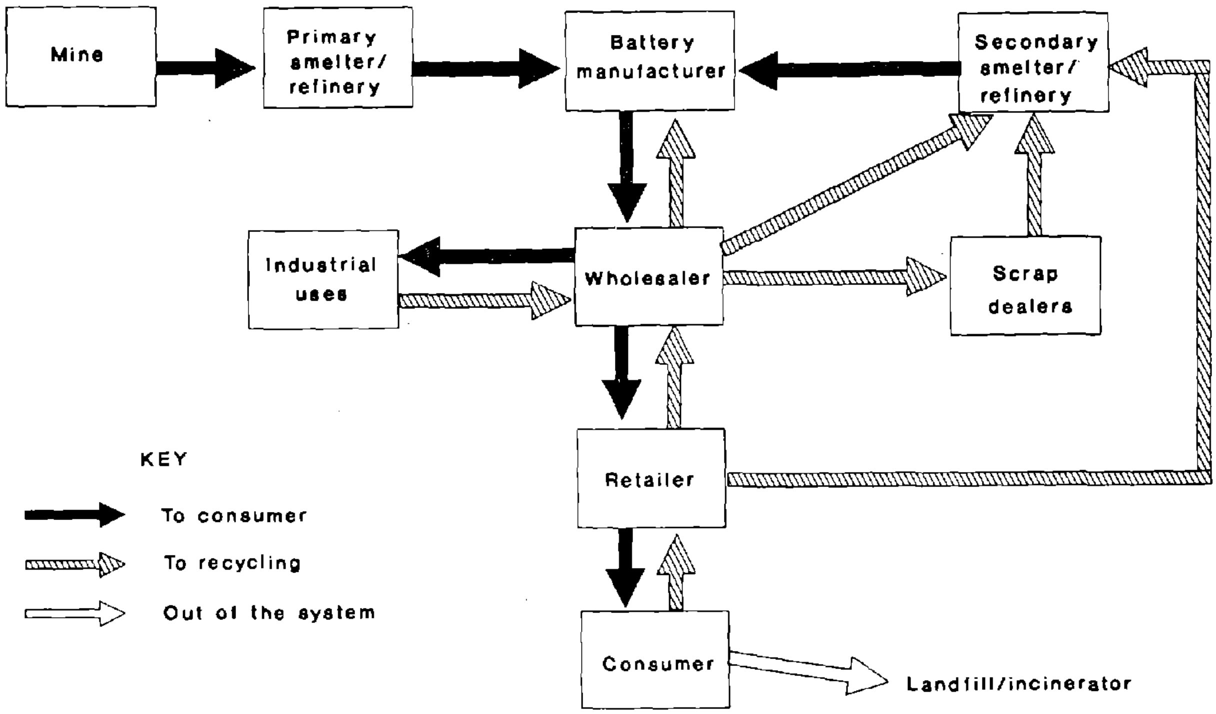


Figure 7.—Lead-acid battery recycling[1] and the lead price,[2] lagged 1 year.

Thirty-three States[23] have enacted battery recycling legislation in recent years. Most of the States adopted the major provisions of the Battery Council International model battery recycling legislation, which includes provisions that (1) prohibit disposal of lead-acid batteries in landfills and

[23]The 33 States are: Arizona, Arkansas, California, Connecticut, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Oregon, Pennsylvania, Rhode Island, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming.



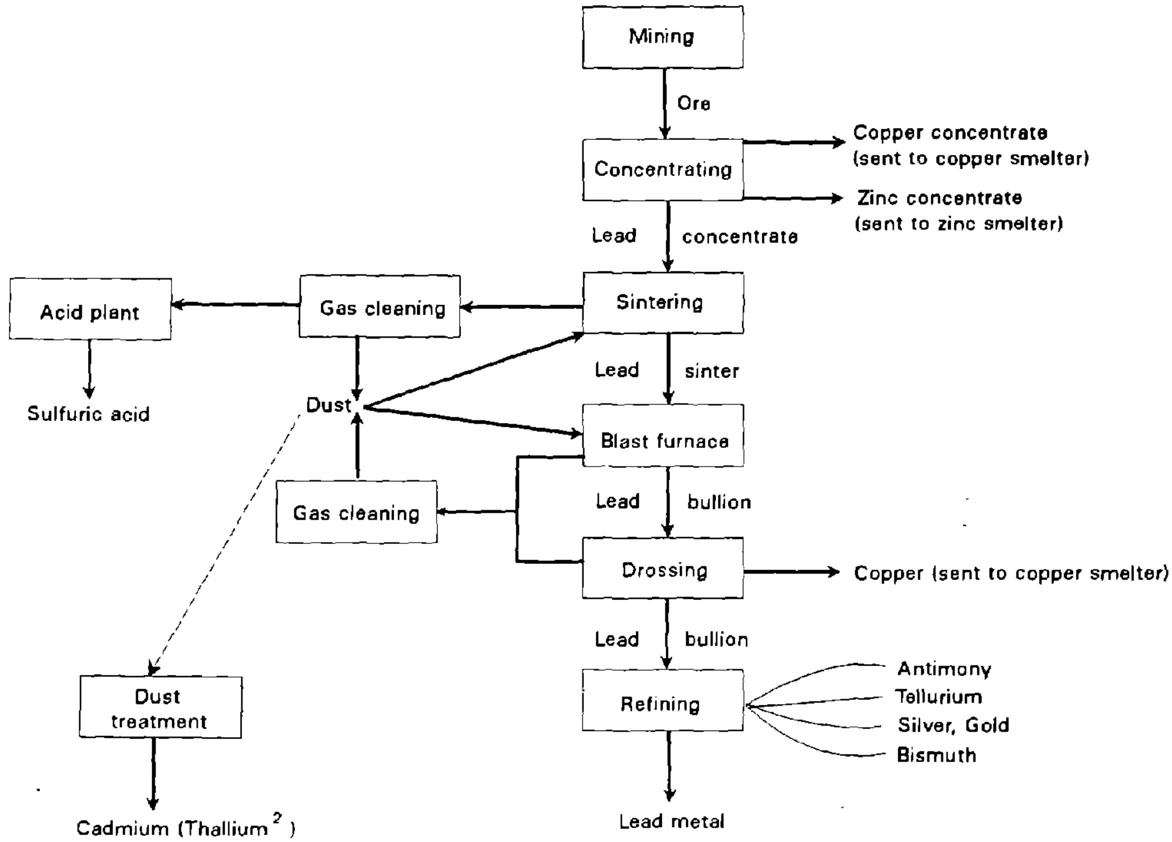
[1] Includes SLI and industrial batteries; does not include small consumer batteries.

Figure 8.—Lead-acid battery recycling system.[1]

require consumers to deliver used batteries to battery retailers, wholesalers, or collection facilities; (2) require battery retailers to display public information to educate the public about the requirement of lead-acid battery recycling programs; (3) require battery retailers and wholesalers to accept from their customers the same number of used batteries as batteries sold; and (4) levy fines on individuals who improperly dispose of lead-acid batteries and battery retailers or wholesalers who do not follow the provisions of the legislation.

The well-developed system to collect and recycle lead batteries is illustrated in figure 8. Most spent lead batteries are collected in this system, delivered to smelters, and recycled. On one major path or loop in the system, the retailers that sell batteries also collect and pay for old batteries from consumers and then sell them to wholesalers, who in turn sell them to battery manufacturers or secondary refineries. The recycling system is also a secondary supply system for an integrated battery manufacturer. An integrated battery manufacturer who has a secondary lead smelter is able to obtain a constant supply of secondary feedstock for the smelter by collecting spent batteries at the retail operation and sending them back through the distribution chain to the smelter. This integrated battery manufacturer/secondary lead producer gains some control over the secondary feedstock supply and is, at the same time, encouraging consumers to dispose of used batteries properly.

Despite State legislated lead-acid battery recycling, a well-developed scrap battery collection system, a well-defined market for secondary lead, and relatively high prices for lead in recent years, a small percentage (5% in 1990) of batteries was not recycled because of logistical difficulties and the inconvenience for consumers in the collection process. In addition, there is no recycling system for small consumer batteries, which constitute about 1% of domestic battery lead consumption.



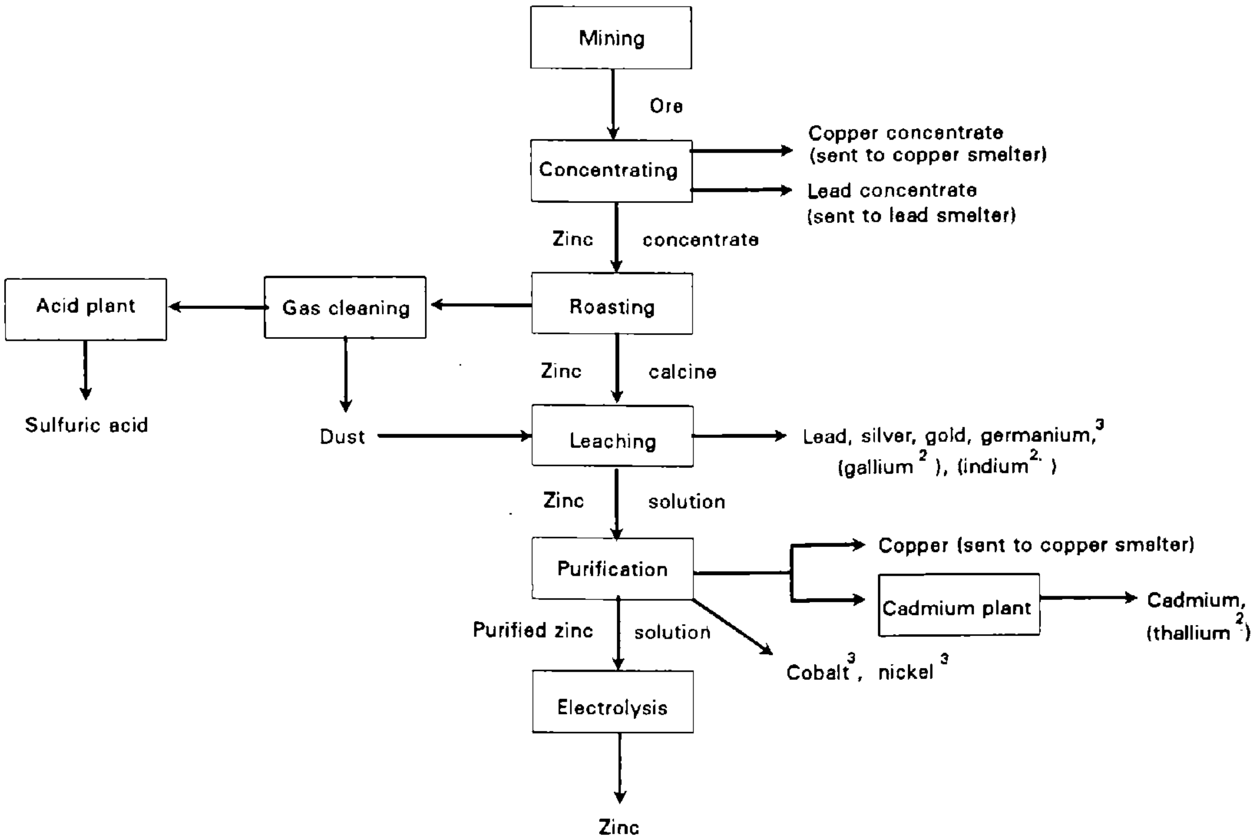
[1] Foster, R.J. Byproduct Output from the Domestic Primary Copper, Lead, and Zinc Industries. U.S. Bureau of Mines IC 9292, 1991.
[2] This metal may be present but it is no longer commercially recovered at domestic plants.

Figure 9.—Lead processing schematic.[1]

LEAD COPRODUCT AND BYPRODUCT PRODUCTION

Lead and zinc commonly occur together geologically. In all of the U.S. lead (and most of the U.S. zinc) deposits that are mined, zinc and lead are coproducts or one is a byproduct of the other.[24] Because the definition of byproduct and coproduct is based on revenue generation by each mineral, their coproduct versus byproduct status changes. In 1990, the price per pound of zinc was twice that of lead. As a result, only 10% of the primary lead produced in 1990 was

[24]Precious metals and base metals may not be designated as coproducts. The U.S. Bureau of Mines classifies an ore as "base metal" or "precious-metal" ore depending on which classification has more than 50% of the value of the ore. Then, the base metal or precious-metal deposit is considered to be a single mineral deposit if at least 75% of the revenues, at current prices, from mining the deposit will be generated by recovery of one mineral. In this case, the other minerals recovered are designated as byproducts. If at least 75% of the estimated deposit revenues are generated by two minerals, the minerals are designated as coproducts and the deposit is considered a two-mineral deposit, e.g., lead-zinc deposit. If recovery of three minerals generates 75% of the deposit revenues, then the deposit is a three-mineral deposit, e.g., lead-zinc-copper deposit. Any other minerals recovered from this deposit are designated as byproducts. Because the prices of minerals vary from year to year, the designation of the deposit and the coproduct versus byproduct status of minerals in a deposit can change.



1 Foster, R.J. Byproduct Output from the Domestic Primary Copper, Lead, and Zinc Industries. U.S. Bureau of Mines IC 9292, 1991.

2 This metal may be present but it is no longer commercially recovered at domestic plants.

3 Upgraded outside the United States.

Figure 10.—Electrolytic zinc processing schematic.[1]

from "lead" deposits—90% of primary lead was produced from deposits for which a significant share of the mine revenues was obtained from the production of zinc, copper, silver, or gold.

Lead and zinc have been designated by legislation[25] as strategic and critical materials—there is insufficient domestic production to meet estimated emergency domestic requirements. Domestic lead-zinc operations produce many important byproducts that also have essential military and civilian applications, including antimony, bismuth, cadmium, cobalt, copper, germanium, gold, indium, nickel, silver, and tellurium. A generic processing schematic for domestic lead and zinc operations is illustrated in figures 9 and 10.

Following is an overview of the market (and later an impact analysis of primary lead taxes on production) for those lead coproducts and byproducts that provide, or are estimated to provide through the 1990's, at least 10% of domestic consumption requirements. The lead coproducts and byproducts meeting that criteria include zinc, bismuth, cadmium, silver, indium and germanium.

[25]Section 12(a), Strategic and Critical Materials Stockpiling Act, as amended (P.L. 101-189).

ZINC

U.S. Demand

Zinc-containing products are used extensively by the military, industry, and the general public in construction, transportation, electrical, machinery, and chemical applications. The United States consumed about 991,000 metric tons of zinc in 1990. The construction sector was the largest consumer of zinc, accounting for an estimated 46%, followed by transportation, 21%; machinery, 12%; and electrical, 12%.

Zinc metal uses are based on a number of its physical properties, mainly its low melting point, which facilitates shaping by casting; its high electrochemical activity, which provides cathodic corrosion protection for iron and steel products; and its ability to alloy with copper to make brass, imparting characteristics of workability at low temperatures, corrosion protection, and attractive finishes. Galvanizing, the process of coating steel products with zinc, protects steel against corrosion by providing a durable barrier, which prevents contact between the steel base and its corrosive surrounding.

In construction, galvanized steel is used extensively in industrial plants, farm structures, bridges, roads, and residential and commercial buildings. The transportation sector, mainly the automotive sector, uses zinc diecast components throughout the automobile. Zinc is also used for corrosion protection of undercarriage and body parts as well as a wide variety of machinery and electrical applications.

U.S. Supply

Zinc and lead are usually mined as coproducts. In every producing domestic lead deposit and in most producing domestic zinc deposits, the other mineral is an important coproduct.

In 1990, domestic production of slab zinc was about 360,000 metric tons—providing about 36% of domestic zinc metal consumption requirements. Primary zinc concentrate production accounted for more than 70% of domestic slab zinc production, and secondary materials provided the remainder. About 40% of domestic concentrate requirements were met with imports. The major sources of zinc imports are Canada, Mexico, Spain, and Peru.

SILVER

U.S. Demand

Silver is a metal critical to the production of many manufactured products owing to its high electrical conductivity, resistance to oxidation, and strength over a wide range of temperatures. It is essential to the manufacture of photographic film, while other silver compounds find important uses in medicine. It is not a designated strategic and critical material because there are sufficient secure sources of supply, including domestic production, to meet estimated emergency requirements.

In 1990, apparent U.S. silver consumption was about 130 million ounces, primarily used in industrial applications. An estimated 50% of domestic consumption is in photographic applications, 25% in electrical and electronic products, and the remainder is primarily used in electroplated ware, jewelry, and solders. Silver is also a precious metal which, like gold, is held as a hedge against inflation.

U.S. Supply

In 1990, U.S. silver mine production was 62 million ounces. About 20% of this total was produced as a byproduct of lead-zinc operations. Lead-zinc byproduct production of silver will increase substantially as the zinc-lead-silver mine in Alaska, Red Dog, is brought into full operation. It is estimated that more than 1.5 million ounces of silver can be recovered annually from the Red Dog Mine.

Silver is produced in association with lead in Alaska, Colorado, Idaho, Missouri, Montana, and Nevada. Silver was produced from precious-metal ores in 90 domestic mines and as a byproduct of copper, lead, and zinc ores from 50 mines.

U.S. imports in 1990, about 112 million ounces, satisfied more than one-half of U.S. demand. Canada and Mexico together supplied 90% of the imports.

BISMUTH

U.S. Demand

Bismuth is a designated strategic and critical material because of its importance in chemical and metallurgical applications. Chemical applications include therapeutic, cosmetic, and industrial and laboratory chemicals. In 1990, domestic bismuth consumption was about 1,400 metric tons. The largest use for bismuth, accounting for 49% of 1990 consumption, is in chemical and pharmaceutical applications. Bismuth is also used as an additive to malleable cast iron to improve metal integrity, as an additive to certain grades and types of steel and aluminum to provide free-machining properties, and in low-melting-point alloys (fusible alloys) for its machining properties. In 1990, 29% of domestic bismuth consumption was in metallurgical additives and 20% of domestic consumption was in fusible alloys.

U.S. Supply

Bismuth rarely occurs in sufficient concentrations to permit commercial recovery as a principal product; it is usually produced as a byproduct of base metal production, most typically lead. The only domestic primary production of bismuth occurs as a byproduct of lead production. ASARCO Incorporated is the sole domestic producer of primary bismuth at its lead refinery in Omaha, Nebraska. The domestic refinery processes lead bullion from Asarco's lead smelter at East Helena, MT, which smelts lead concentrates of domestic and foreign origin. Bismuth is not produced from Missouri lead ores because of the low bismuth content in those ores.

Secondary production of bismuth is negligible and domestic primary production provides less than 10% of domestic consumption requirements.

Net imports provided about 90% of domestic consumption requirements. The major import sources for bismuth from 1986-89 were Belgium (32%), Mexico (26%), Peru (16%) and the United Kingdom (11%).

CADMIUM

U.S. Demand

Cadmium has been designated a strategic and critical material because of its importance in specialized military applications such as plating and rechargeable batteries. In 1990, domestic cadmium consumption was about 3,700 metric tons. The primary applications and their share of 1990 domestic consumption are nickel-cadmium batteries, 40%; coating and plating, 25%; pigments, 13%; and plastics and synthetic products, 12%.

Nickel-cadmium rechargeable batteries are used in a wide variety of applications—locomotives, aircraft, as a standby electrical supply for aircraft and ships, in alarm systems, lighting equipment, and signaling devices. Nickel-cadmium batteries are also used in manufactured products such as computers, telephones, calculators, and portable appliances. Cadmium coatings are used to impart specific properties to metal products in the electrical, electronic, automotive, and aerospace industries. Cadmium coatings on iron, steel, brass, and aluminum give these metals excellent resistance to corrosion in most conditions and especially in marine and alkaline environments.

Cadmium pigments are used as stable inorganic coloring agents in plastics and paints. The cadmium pigments offer high-temperature stability, brilliant colors, high opacity, and resistance to chemical attack and degradation by light. Cadmium compounds are used as stabilizing compounds in polyvinyl chloride to retard the degradation processes that occur on exposure of these materials to heat and sunlight.

U.S. Supply

Cadmium is produced exclusively as a byproduct of primary zinc (zinc-lead) production and to a lesser extent, from lead smelter flue dusts. In 1990, domestic production was about 1,700 metric tons—providing 46% of domestic cadmium requirements. Domestic production has declined substantially since the 1960's when the United States produced 4,000 to 5,700 metric tons of cadmium—largely supplying its own requirements.

In 1990, primary slab zinc production was down 72% from the peak attained in 1969. The decline in cadmium recovery largely reflects the declining zinc production capacity. Cadmium is recovered domestically by four firms at five sites: Big River Zinc Corp. in Illinois, ASARCO Incorporated in Colorado, Jersey Miniere Zinc Co. in Tennessee, and the Zinc Corp. of America in Oklahoma and at its Pennsylvania zinc smelter.

GERMANIUM

U.S. Demand

Domestic consumption of germanium in 1990 was estimated at 36,000 kilograms, a 10% decrease from the previous year. Germanium is designated a strategic and critical material owing to its importance in military applications. The majority of the germanium consumed was used in infrared optics, predominately in military guidance and weapon-sighting systems. Germanium-containing lenses and windows transmit thermal radiation similarly to visible light transmission by optical glass. This end use accounted for 60% of the consumption during 1990. Other major uses and their share of 1990 consumption were: semiconductors, 10%; electronic detectors, 9%; and fiber optics, 8%.

U.S. Supply

Germanium rarely occurs in sufficient concentrations to permit commercial recovery as a principal product.[26] It is usually recovered as a byproduct of base metal refining and extracting, more specifically, zinc processing. In 1990, domestic production of refined germanium from both primary (byproduct) and secondary sources was estimated at 18,000 kilograms. Germanium was produced in 1990 from either processed residues from certain domestic ores, industry-generated scrap or imported raw materials.

The following companies produced refined germanium in the United States during 1990: Jersey Miniere Zinc Co.,

[26]Germanium and gallium have been recovered as the principal products by St. George Mining Corp., now the Hecla Mining Co., in Utah.

Clarksville, TN; Eagle-Picher Industries, Inc., Quapaw, OK; Kawecki Berylco Industries, Inc. (KBI), a Division of Cabot Inc., Revere, PA; and Atomergic Chemetals Co., Plainview, NY. Jersey Miniere produced germanium-rich residues based on its utilization of zinc ores from its Gordonsville and Elmwood, Tennessee mines. These germanium residues were shipped to Metallurgie Hoboken-Overpelt S.A. in Belgium for germanium recovery and refining. Both KBI and Atomergic Chemetals produced germanium from reprocessed scrap and semirefined foreign materials. Eagle-Picher reprocesses scrap and also has the capability of recovering primary germanium from zinc smelter residues. An estimated 40,000 kilograms of germanium was imported during 1990.

Hecla Mining Co., St. George, UT, had acquired the St. George Mining Corp.'s facilities in Utah and in 1990 planned to resume production of germanium (20 mt/yr) and also gallium as principal products from iron oxide materials but has suspended operations because of technical problems. Cominco Alaska Inc. has recently begun germanium recovery from its Alaskan Red Dog Mine concentrate. Red Dog is one of the world's largest producers of zinc and lead. Actual germanium production estimates are not available, however, content of the concentrates is estimated at 50 mt (50,000 kg) per year, equivalent to 147% of 1990 domestic germanium consumption. All the Red Dog germanium source materials are refined outside of the United States.

INDIUM

U.S. Demand

Indium was designated a strategic and critical material in 1989 because of its importance in such applications as laser diodes for fiber optics, high-speed semiconductors, gaskets for cryogenic appliances, infrared detectors, and specialty solders for computers.

In 1990, domestic indium consumption was about 28,000 kilograms. The main applications and their share of 1990 domestic consumption are: solders and alloys, 45%; thin coatings on the glass of liquid crystal displays and heat-reflecting window coatings, 30%; and electrical and electronic components, 15%.

U.S. Supply

Indium occurs as a trace constituent of other metal deposits, principally zinc, but also lead, tin, tungsten and iron. Domestically, indium is recovered from imported zinc residues, slags, flue dusts, and intermediate compounds resulting from the smelting process. Two companies accounted for all refined indium in the United States: Arconium Specialty Alloys, Providence, RI, and Indium Corp. of America, Utica, NY. Plans are underway to recover indium from a domestic source outside the United States. The estimated potential indium production from this source is 11 metric tons (11,000 kg).

The major import sources from 1986-89 for refined indium were Belgium (23%), United Kingdom (17%), Italy (16%), and France (15%).

ENVIRONMENTAL ISSUES

Lead has significant adverse impacts on human health and the environment. Not all the health effects of different levels of lead exposure are fully understood. Historically, the primary health concern has been human exposure to relatively high levels of lead. The adverse effects of these levels have been observed and documented principally in preschool children but also fetuses, the general population, and occupational groups.[27]

Environmental concerns are associated with lead production, using lead-containing products, and disposal of lead-containing products. Each is described below.

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[27]Booz-Allen & Hamilton. Background Paper: The Lead Problem and Lead Management Activities. Prepared for Office of Policy Analysis, EPA, Aug. 1990, p. 20.

The Bureau of Mines has initiated a cooperative agreement with the Science Policy Research Unit of the University of Sussex, United Kingdom, to assess the effectiveness of alternative policy options to reduce lead in the environment. The objectives of the cooperative study are to:

- Assess the available evidence concerning the relative importance of the different sources of lead, and pathways of human exposure to lead, for different groups in the population of the United States.
- Review the current scientific theories and evidence concerning the effects of low levels of lead on human health, and to estimate the toxicological implications of reducing various sources of human exposure to lead.
- Identify and analyze the relative merits of various practical methods for reducing human exposure to lead in the environment.
- Assess the utility of several alternative approaches to reducing or inhibiting the accumulation of lead in the environment and to identify technologies that could assist in this goal.

PRIMARY AND SECONDARY LEAD PRODUCTION

In primary and secondary production, wastes and process emissions are generated during the smelting and refining of lead. Process emissions of lead particulate matter are captured and treated in high-efficiency baghouses and scrubbers before they are released. The primary lead industry's production activities generate lead particulates in ambient air and the potential for lead absorption by workers exposed to lead particulates. A lead slag is also produced.

The same environmental lead issues are present with secondary lead production. The pollutant or emission from the secondary lead industry of principal concern is slag and, to a lesser extent, lead particulates and organic waste disposal. Secondary smelter feedstock is predominantly scrap automotive batteries that contain sulfuric acid, which must be converted to a product or neutralized for disposal.

Regulations that impact the domestic lead industry, i.e., the domestic production of lead, are based on mandates given to regulatory agencies in the Clean Air Act (CAA), the Clean Water Act (CWA), the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL), OSHA's Medical Removal Program (MRP), the Resource Conservation and Recovery Act (RCRA), and the Solid Waste Disposal Act (SWDA). The applicable parts of the Federal regulations that affect the domestic primary and secondary lead industries are presented in table 3.

Table 3.—Pertinent environmental and health and safety regulations affecting the domestic lead industry

Regulation	Date promulgated
Health and safety	
OSHA - Permissible exposure limit. Occupational exposure to inorganic lead limited to 50 µg/m³ (time-weighted average) by engineering controls.	3/1/79
OSHA - Medical removal program. Final Lead Standard. Action level 50 µg/100 g. Return level 40 µg/100 g following two consecutive blood-lead tests.	3/1/83
Clean air	
Particulates	
Lead: EPA - Clean Air Act/National Ambient Air Quality Standard	
Primary and Secondary standards amended to 1.5 µg/m³ arithmetic mean over calendar quarter or plant boundary.	10/5/78
SO_2	
EPA - National Primary and Secondary Ambient Air Quality Standards:	7/1/85

Ambient concentrate limits SO_2 (arithmetic average) µg/m³	Ambient concentrate limits SO_2 (arithmetic average) ppm	Averaging period
1,300[1]	0.50	3 hours
365[1]	0.14	24 hours
80[1]	0.03	1 year

Regulation	Modified period
Clean water	
EPA - Clean Water Act. State regulations more stringent than Federal. Best Available Technology, Lime, settle.	1970-77
Federal Clean Water Act. Best Conventional Technology. Best Demonstrated Technology. Discharge during 25-year, 24-hour rainfall on settling ponds.	1983-84
RCRA "Third-Third"	
Pretreatment Rule for lead content to municipal waste landfills (MWLF). (Primarily affects secondary smelter refinery slags and any other solid waste to MWLF. Primary slags are to be managed under RCRA subtitle D regulations and probably under Mine Waste Rules that are currently under development by EPA.)	

Prior to midyear 1990	Interim effective midyear 1990	Final midyear 1992
50 mg/l (EP Tox.)[2]	5 mg/l (EP Tox.)[2]	.5 mg/l (TCLP)[2]

[1] Not to be exceeded more than once per year.

[2] Extraction procedure toxicity characteristic test (EP Tox.). Toxicity characteristic leaching procedure test (TCLP). Both of these tests constitute a series of laboratory operations and analyses designed to determine whether, under severe conditions, a solid waste, stabilized waste, or landfilled material can yield a hazardous leachate.

Source: U.S. Bureau of Mines. Impact of Existing and Proposed Regulations on the Domestic Lead Industry (updated with current information). (OFR-88, 1988).

Domestic environmental and worker health and safety regulations concerning lead emissions have become increasingly stringent since 1971. The resulting compliance costs have added significantly to domestic production costs. In a study conducted in 1987, the Bureau of Mines estimated the costs and the economic impacts of existing and proposed environmental and health and safety regulations to the domestic primary and secondary lead industry.

From 1970 to 1985, capital expenditures by the lead industry for compliance are estimated at $221 million and the regulatory operating costs are estimated at $0.025 per pound for refined primary lead and $0.03 per pound for secondary. Average production costs were estimated at $0.231 per pound for primary and $0.238 per pound for secondary. (In the last 5 years the annual price of lead has ranged from $0.19 to $0.39 per pound.)

The impacts of proposed national ambient air quality standards were also analyzed. The Bureau estimates that under an ambient air standard of .5 g/m^3, secondary production costs could be expected to increase by $0.02 per pound. (In addition, the proposed revised drinking water standard could more than double the additional compliance cost to secondary plants.) For primary plants, technology is unavailable to meet the proposed revision.[28]

CONSUMPTION

Aside from primary and secondary lead production, lead can pose health risks by emission into the environment and by direct exposure. Because of its toxicity if ingested, the use of lead in ceramic glazes, enamel frits, shot for hunting migratory waterfowl, interior and exterior residential paints, and pipes and solders in municipal water systems has significantly declined or has been eliminated.

[28]Isherwood, Raymond J., Craig R. Smith, Orville A. Kiehn, and Michael R. Daley. Impact of Existing and Proposed Regulations on the Domestic Lead Industry; BuMines; OFR 55-88, 1988.

DISPOSAL OF LEAD-CONTAINING PRODUCTS

Discarded lead-containing products have become an environmental and, in turn, a complex regulatory issue. The lead in lead-containing products that are sent to a municipal solid waste landfill may leach into ground water. If the lead-containing products are sent to a municipal solid waste (MSW) incinerator, emission of lead particulates into the air as well as the leaching of lead contained in incinerator ash into the ground water are potentially serious environmental problems.

The EPA Lead Waste Minimization Work Group recently completed an assessment of the risks due to inhalation and ingestion of lead emitted from primary and secondary smelters and municipal waste combustors (MWC's).[29] The working group concluded that the "worst-case" risks due to inhalation or ingestion of lead emitted from MWC's and MSW landfills are relatively low, meeting the standards of the current National Ambient Air Quality Standards. The new solid waste requirements for municipal solid waste management under Subtitle D of the Resources Conservation and Recovery Act, will reduce the lead exposure risk further.

[29]William Woodbury, lead specialist, U.S. Bureau of Mines. Private communication, Nov. 1990.

ESTIMATED U.S. PRIMARY LEAD TAX IMPACTS

This section provides an analysis of the minerals related impacts of a tax on U.S. primary lead production and primary lead imports.[30] Included in the analysis are the impacts of the tax on: (1) the U.S. lead price and U.S. secondary lead imports and secondary production; (2) domestic primary lead production; (3) domestic lead coproduct and byproduct production, which provide at least 10% of domestic consumption requirements (including bismuth, cadmium, germanium, indium, silver, and zinc production); (4) domestic secondary capacity; (5) the competitive position of domestic integrated and nonintegrated secondary producers; (6) the domestic lead recycling activity; and (7) U.S. imports of primary lead.

[30]The analysis assumes that the tax will be identical for domestic primary lead production; imports of primary lead, including primary lead metal; contained lead in imported lead concentrates; and primary lead contained in imported manufactured products.

THE U.S. LEAD PRICE AND U.S. SECONDARY LEAD IMPORTS AND SECONDARY PRODUCTION

A tax on domestic primary lead production and primary lead imports could be expected to initially effect an increase in the price for primary lead and an equal upward pressure on the price for secondary lead.[31] Both economic

[31]Primary production refers to lead metal extracted from ores. Secondary production refers to lead recovered from lead scrap, primarily spent lead-acid batteries.

theory and empirical evidence support the proposition that demand for lead is not price elastic, allowing most or all of the tax to be passed on to the consumer in the form of a higher price. Thus, immediately following the implementation of a primary lead tax there would be a new U.S. lead price, which would be higher than the rest-of-world lead price by an amount less than or equal to the tax rate. If the domestic lead price increases by the amount of the tax, no initial impact on domestic primary production of lead and lead coproduct and byproduct production is estimated.

The premium U.S. lead price resulting from the tax, however, will fall as supplies of untaxed (lower cost) secondary lead, both imports and domestic production, increase. These additional U.S. lead supplies (increased imports of secondary lead and domestic secondary production) can then be expected to exert a downward pressure on the U.S. lead price. As the U.S. lead price declines, the higher cost (taxed) domestic primary supplies will also decrease and be displaced by the untaxed U.S. secondary supplies, both secondary imports and domestic secondary production.

In the longer term, perhaps 1 to 3 years, when resources are mobile and contracts expire,[32] expanded imports of secondary lead[33] and increased domestic secondary production, through increased domestic capacity utilization and expansion, will continue to exert downward pressure on the U.S. lead price. Domestic primary lead production will become less competitive with secondary supplies as a result of the tax, and domestic primary producers who are unable to cover production costs with anticipated revenues will close. The higher U.S. lead price and secondary industry profits will encourage expansion of the domestic secondary industry. Expanded secondary supplies, i.e., increased imports of secondary and expanded domestic secondary production, will displace domestic primary lead production that becomes uncompetitive. The maximum U.S. price premium that could be expected will be equal to transportation costs of importing secondary lead and lead scrap.

[32]According to some industry sources, the lead price is not usually set in lead purchase contracts until the time of shipment. At the time of shipment, the price set is based upon the currently quoted spot price for lead plus discounts or premiums depending on whether terms are producers or LME-based. Further, the contract term reported is typically 90 days or less. Both of these factors could be expected to speed up the adjustment process.

[33]An expansion of U.S. secondary imports does not require an expansion of foreign secondary capacity because excess foreign primary production capacity is more than four times the sum of the total potential reduction in U.S. primary production and the maximum estimate of foreign secondary supplies exported to the United States after the tax. Any decrease in available secondary supplies for foreign consumption can easily be filled by expanded foreign primary production. World primary lead production capacity in 1989, excluding the United States, is estimated at 4,000,000 metric tons, while primary lead production (excluding the United States) is estimated at 2,250,000 metric tons.

QUANTITATIVE ESTIMATES OF THE IMPACTS ON PRIMARY LEAD AND LEAD COPRODUCT AND BYPRODUCT PRODUCTION RESULTING FROM ALTERNATIVE PRIMARY PRODUCTION TAXES

The longer term impacts, impacts beginning within 1 to 3 years following the implementation of the tax upon domestic primary lead and lead coproduct and byproduct production, have been estimated for a range of primary lead taxes. The economic impacts were estimated using the Bureau of Mines Supply Availability Model (SAM). The SAM is a cash-flow simulator that provides for the economic analysis of mineral properties under various scenarios. Results are either in the form of a discounted-cash-flow rate of return and net present value; or the average total cost of production, less all byproduct revenues, is estimated for the primary product.[34]

The analysis includes most of the major lead-producing properties (table 4). The estimated total annual production from these properties is 415,000 metric tons, equivalent to 99% of 1989 domestic lead production. The properties are in Alaska, Colorado, Idaho, Missouri, Montana, and New York. About 78% of the lead production is from Missouri properties.

Table 4.—Properties included in analysis

Mine	State	Operator
Greens Creek	Alaska	Greens Creek Mining Co.
Red Dog	do.	Cominco Alaska, Inc.
Black Cloud	Colorado	ASARCO Incorporated.
Bunker Hill	Idaho	Bunker Hill Mining Co. (U.S.) Inc.
Buick	Missouri	The Doe Run Co.
Casteel	do.	Do.
Doe Run	do.	Do.
Magmont	do	Cominco American Inc.
West Fork	do.	ASARCO Incorporated.
Butte Hill	Montana	New Butte Mining Co. Inc.
Montana Tunnels	do.	Montana Tunnels Mining Inc.
Balmat & Pierrepont	New York	Zinc Corporation of America.

Domestic lead-producing deposits also provide a significant proportion of the domestic supply for several other important metals. Relative to 1989 production, the study properties will produce an estimated:

- 99% of domestic primary lead production
- 125% of (domestic) primary zinc production (per year)
- 91% of bismuth production

[34]Catherine C. Kilgore, supervisory minerals specialist with the Minerals Availability Field Office prepared the production cost estimates using the Minerals Availability Program's Supply Availability Model (SAM).

- 130% of cadmium production
- 16% of silver mine production.

The study properties will also provide the only significant domestic source of germanium and indium presently available.

Primary lead production taxes assessed ranged from $0.04 per pound, equivalent to 10% of the 1990 market price for lead ($0.40 per pound) to a tax of $1.25 per pound, more than three times the average 1990 market price.

ESTIMATED PRODUCTION IMPACTS
$0.04 per pound tax (10% tax)

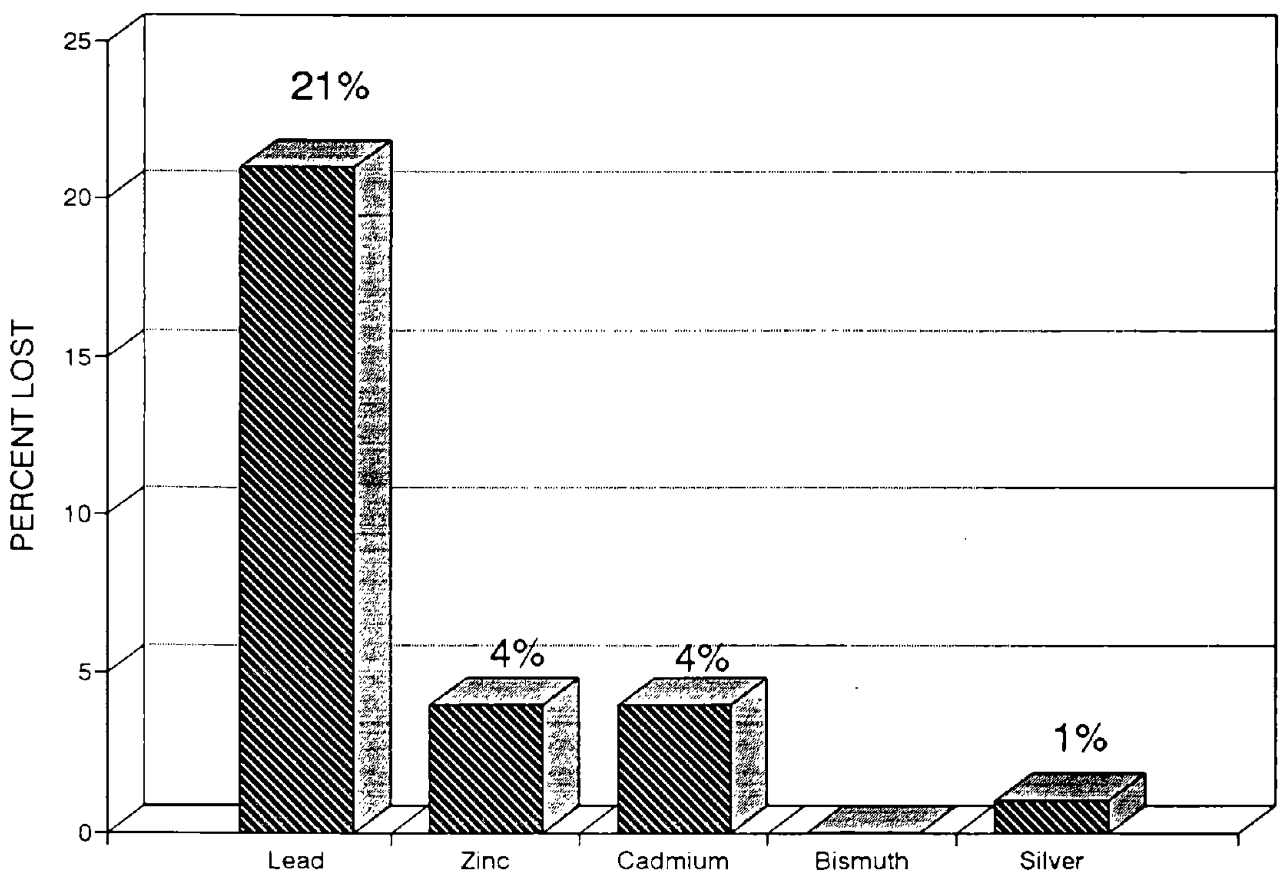
One of the 12 study properties becomes uneconomic with a $0.04 per pound tax on primary lead. The economic production of domestic source primary mineral production (per year), as a result of the $0.04 per pound primary lead production tax, is estimated to decrease as follows:

- Lead: 21% (87,000 metric tons)
- Zinc: 4% (15,000 metric tons)
- Bismuth: 0%
- Silver: 1% (.5 million troy ounces)
- Cadmium: 4% (70 metric tons)

The impact of a $0.04 per pound tax on primary lead production on domestic production of lead, zinc, bismuth, cadmium, and silver is illustrated in figure 11.

$0.10 per pound tax (25% tax)

Imposing a primary lead tax rate of $0.10 per pound (25% of the 1989 price for lead) results in five additional properties becoming uneconomic. The uneconomic proper-



[1] Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

Figure 11.—Estimated loss of domestic production[1] of lead, zinc, cadmium, bismuth, and silver under a primary lead tax of $0.04/pound.

ties are in Colorado, Missouri, and Montana. The economic production of domestic source primary mineral production, as a result of the $0.10 per pound primary lead production tax, is estimated to decrease as follows:

- Lead: 77% (322,000 metric tons)
- Zinc: 20% (70,000 metric tons)
- Bismuth: 49%[35]
- Silver: 4% (2.7 million ounces)
- Cadmium: 18% (350 metric tons)

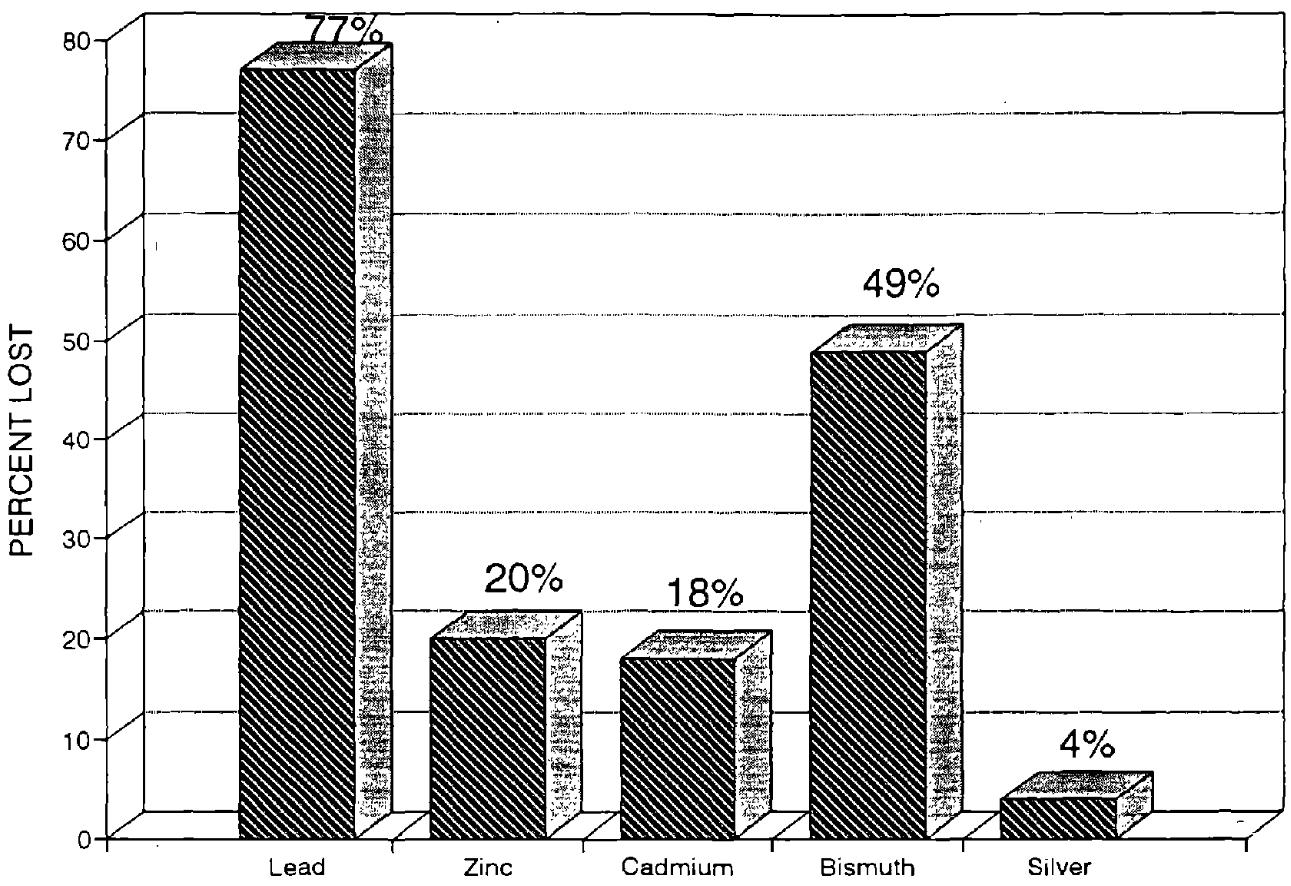
The impact of a $0.10 per pound tax on primary lead production on domestic production of lead, zinc, bismuth, cadmium, and silver is illustrated in figure 12.

[35]Tonnage data withheld to avoid disclosing proprietary data.

$0.20 per pound tax (50% tax)

Imposing a primary lead tax rate of $0.20 per pound (50% of the 1989 price for lead) results in one additional property becoming uneconomic. The seven uneconomic properties are in Colorado, Missouri, and Montana. Economic domestic source primary mineral production, as a result of the $0.20 per pound primary lead production tax, is estimated to decrease as follows:

- Lead: 81% (340,000 metric tons)
- Zinc: 20% (70,000 metric tons)
- Bismuth: 49%
- Silver: 4% (2.7 million ounces)
- Cadmium: 18% (350 metric tons)



[1] Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

Figure 12.—Estimated loss of domestic production[1] of lead, zinc, cadmium, bismuth, and silver under a primary lead tax of $0.10/pound.

The impact of a $0.20 per pound tax on primary lead production on domestic production of lead, zinc, bismuth, cadmium, and silver is illustrated in figure 13.

$0.40 per pound tax (100% tax)

Imposing a primary lead tax rate of $0.40 per pound (100% of the 1989 price for lead) results in two additional properties becoming uneconomic. The nine uneconomic properties are in Colorado, Idaho, Missouri, and Montana. Economic domestic source primary mineral production, as a result of the $0.40 per pound primary lead production tax, is estimated to decrease as follows:

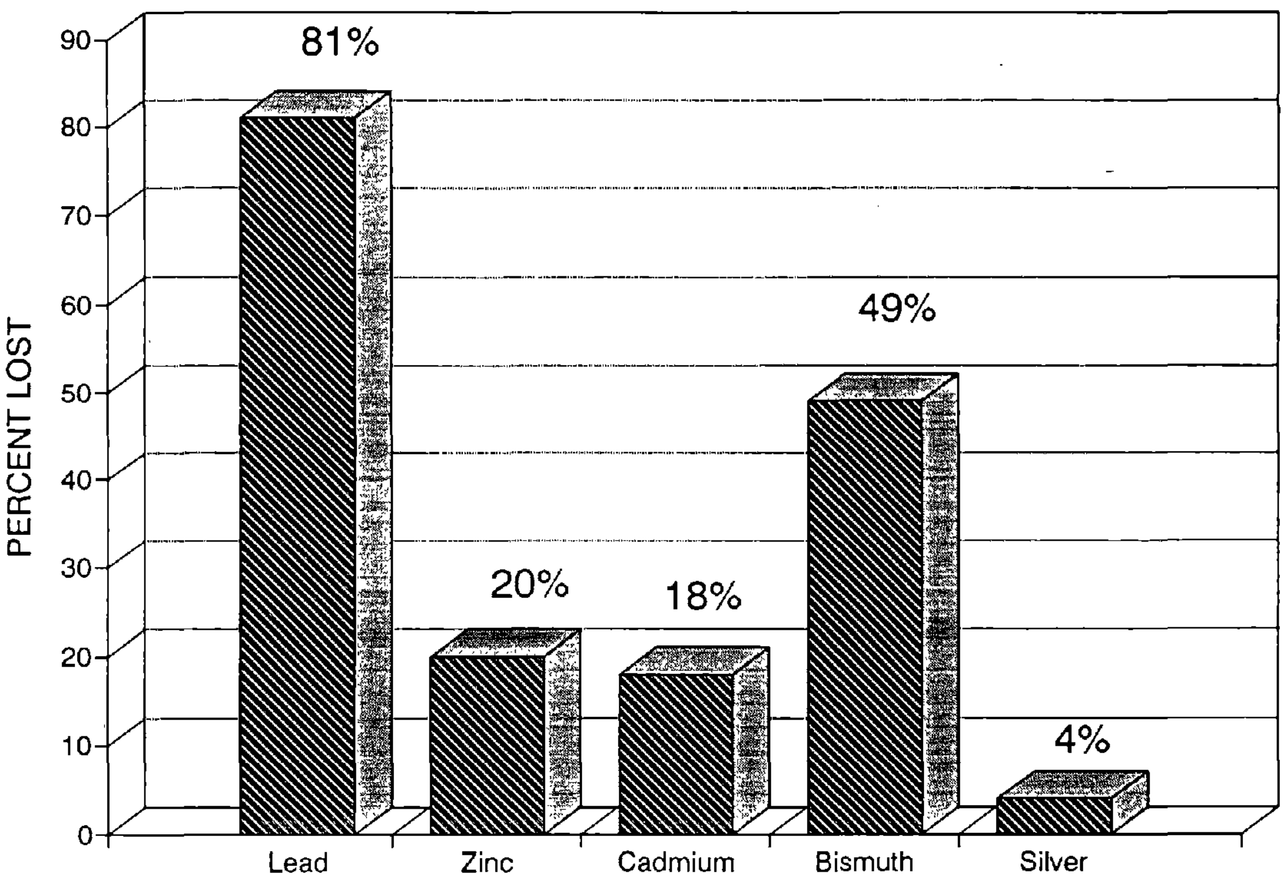
- Lead: 84% (350,000 metric tons)
- Zinc: 30% (100,000 metric tons)
- Bismuth: 89%
- Silver: 6% (3.9 million ounces)
- Cadmium: 28% (560 metric tons)

The impact of a $0.40 per pound tax on primary lead production on domestic production of lead, zinc, bismuth, cadmium, and silver is illustrated in figure 14.

$0.80 per pound tax (200% tax)

Imposing a primary lead tax rate of $0.80 per pound (200% of the 1989 price for lead) results in two additional properties becoming uneconomic. The 11 uneconomic properties are in Alaska, Colorado, Idaho, Missouri, and Montana. Economic domestic source primary mineral production, as a result of the $0.80 per pound primary lead production tax, is estimated to decrease as follows:

- Lead: 99% (414,000 metric tons)
- Zinc: 87% (300,000 metric tons)
- Bismuth: 89%



[1] Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

Figure 13.—Estimated loss of domestic production[1] of lead, zinc, cadmium, bismuth, and silver under a primary lead tax of $0.20/pound.

- Silver: 16% (10.0 million ounces)
- Cadmium: 85% (1,800 metric tons)

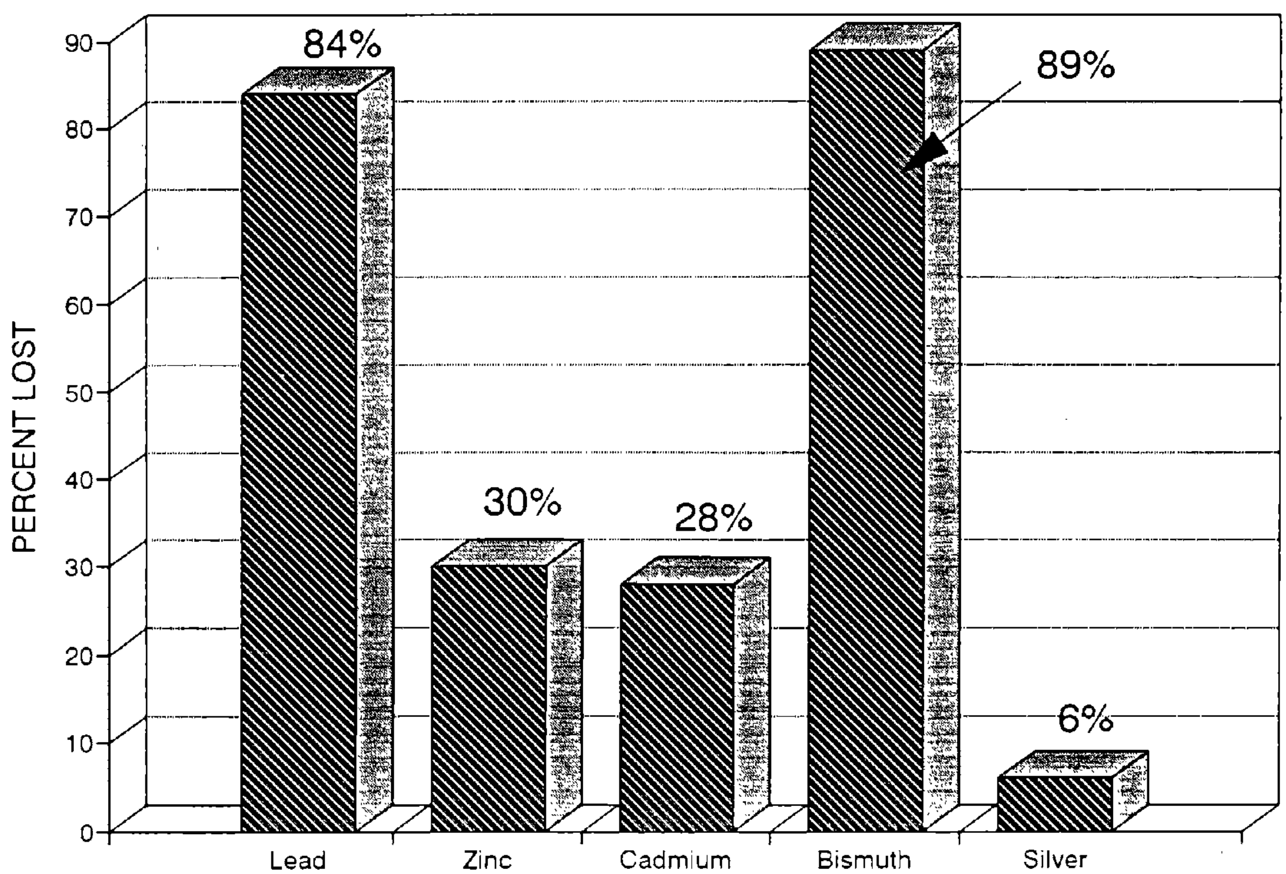
In addition, the most significant domestic sources of germanium and indium will be unavailable. If a tax of $0.80 or more is placed on domestic primary lead production, an estimated 11,000 kg of indium and 50,000 kg of germanium will be unavailable for recovery.

$1.25 per pound tax (300% tax)

Imposing a primary lead tax rate of $1.25 per pound (about 300% of the 1989 price for lead) results in the same estimated impacts as with an $0.80 per pound tax. See figure 15.

DOMESTIC RECYCLING ACTIVITY

A tax on primary lead production and primary lead imports could result in a modest, temporary increase in recycling. If the increase in the U.S. lead price resulting from the primary lead tax resulted in higher prices for scrap batteries, the incentive for consumers to bring in scrap batteries, which are presently not recycled, would increase. However, only a modest, temporary increase in battery recycling could result from this scrap price increase. Factors limiting or dampening the impact of a lead scrap price increase on recycling in the short term include: (1) the high lead battery recycling rate, which has already been achieved



1 Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

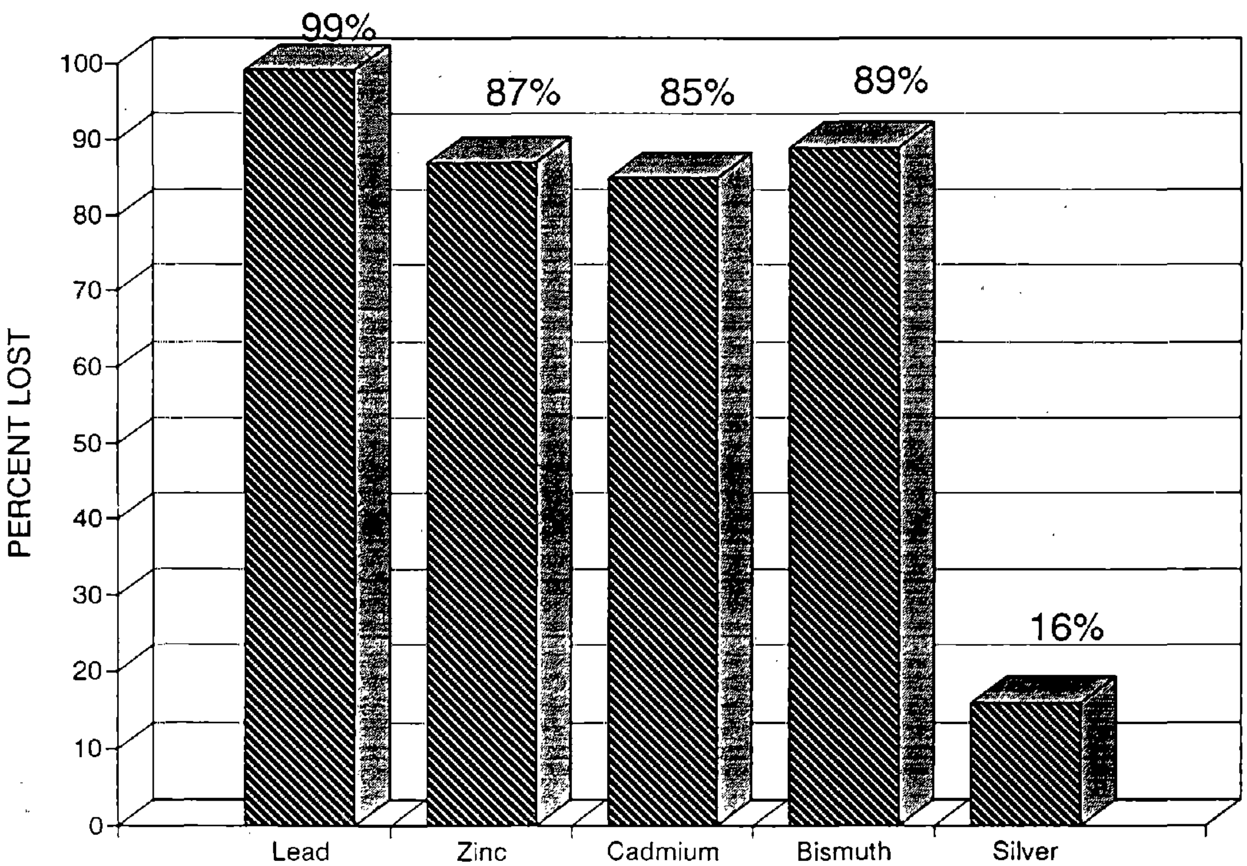
Figure 14.—Estimated loss of domestic production[1] of lead, zinc, cadmium, bismuth, and silver under a primary lead tax of $0.40/pound.

(95% in 1989); (2) the lack of a recycling system for consumer (small) lead batteries. (Only a small amount of lead is contained in each consumer battery—even a large lead price increase cannot be expected to provide sufficient economic incentive for the development of a recycling system for this category of lead batteries.); (3) the costs to the consumer in inconvenience or the logistical costs to take a battery to a collection point may still be greater than the price paid to a consumer for a scrapped battery; and (4) speculation that scrap prices may increase further.

No increase in recycling, even in the short run, can be expected if the increased price offered for secondary lead (as a result of the primary lead tax) does not result in higher prices offered for spent lead batteries.

In the longer run, within 1 to 3 years, little or no increase in domestic recycling activity will take place. Arbitrage[36] will eventually reduce or eliminate the competitive advantage for domestic secondary producers created by the U.S. tax on primary lead production and imports. The maximum

[36]Arbitrage is the process of buying a commodity in one market and selling it at the same time in another market in order to take advantage of the price differential. If the U.S./rest-of-world lead price differential is more than the costs of importing (i.e., transportation and handling) untaxed secondary lead, and there are sufficient alternative sources of lead, foreign secondary producers will find it to their advantage to export their secondary production to the United States. Although foreign producers are acting independently in their own best interest, the total effect of their efforts will be to reduce or eliminate the US./rest-of-world lead price differential.



1 Includes production from properties with a discounted cash-flow of zero or higher and from which the estimated costs are no higher than $0.31/lb, the average 1980-90 adjusted market price of lead (LME price + $0.04/lb).

Figure 15.—Estimated loss of domestic production[1] of lead, zinc, cadmium, bismuth, and silver under a primary lead tax of $0.80 and $1.25/pound.

U.S. lead price premium that could remain in the long run will be equal to the transportation costs, \$0.00-\$0.05 per pound, of importing secondary lead and lead scrap. This maximum price premium would not provide sufficient economic incentive to affect the small amount of vehicular batteries that are not being recycled, less than 5% in 1989, nor provide incentives to develop a collection and haulback system that would promote the recycling of small consumer batteries, which contain an estimated 1% of battery lead.

DOMESTIC SECONDARY LEAD PROCESSING CAPACITY

The higher price for lead and increased secondary profits occurring initially, if sustained for 1 or more years, could lead to overexpansion of the domestic secondary lead industry, i.e., for a limited supply of lead scrap (secondary feedstock) too much refining capacity would result. Because the lead industry and the other metal industries are subject to cyclical behavior, an overexpansion, accompanied by falling prices would result in capacity underutilization, poor industry economic health, and, in turn, a decline in domestic secondary lead production capacity. Such cyclical behavior occurred in the 1980's—high lead prices in the late 1970's were followed by refining capacity overexpansion relative to the scrap supply. Lower lead prices and capacity underutilization were followed by a decline in the domestic secondary processing capacity of 33% in the mid-1980's. In the last several years, capacity has increased and has now reached 1.1 million metric tons. Further capacity expansion may require the importation of lead scrap feedstock in order to utilize capacity. Falling lead prices and/or capacity overexpansion could impair the health of the secondary industry and could lead to another period of declining capacity.

COMPETITIVE POSITION OF DOMESTIC INTEGRATED AND NONINTEGRATED SECONDARY LEAD PRODUCERS

Integrated battery manufacturers who have a secondary smelter and a well-defined collection system for scrap may benefit most from a tax on primary production in the short run, although the initial increase in profits may be reduced if lead scrap prices increase as a result of the higher domestic lead price. The integrated producer with a retail collection system has more control over secondary scrap supply than a nonintegrated producer and is therefore better able to influence the price he pays for lead scrap feedstock. Thus, the primary lead tax could provide the integrated battery manufacturer with a competitive advantage over nonintegrated battery manufacturers (and not affect recycling) in the short run.

In the longer run, when the premium U.S. lead price falls as secondary lead supplies increase, the integrated battery manufacturers/secondary lead producers may retain a slight competitive advantage (the \$0.00-\$0.05 premium on the price of lead) over nonintegrated or "independent" secondary lead producers and nonintegrated battery manufacturers. The producers and manufacturers could, in turn, expect higher scrap prices.

Independent secondary lead producers and nonintegrated lead-acid battery manufacturers may, however, take actions to ensure the continued availability of scrap feedstock. Independent secondary lead producers may gain more control over scrap feedstock through take-back provisions in contracts with battery manufacturers, usually by tolling arrangements. Nonintegrated battery manufacturers may protect the availability of the secondary lead feedstock needed to produce the secondary lead metal they purchase through buy-sell contractual provisions with their supplying secondary lead smelter(s) and buy-back scrap arrangements from their wholesale and retail customers.

U.S. IMPORTS OF PRIMARY LEAD

Imports of primary lead supplies, in addition to imports of secondary lead, may also displace domestic primary supply because enforcement of a tax on imports of primary lead and primary lead contained in products will be difficult, impracticable, and expensive. Outside of the United States, secondary lead is smelted with primary lead resulting in an output that is a mix of primary and secondary lead. To ensure that primary lead metal or manufactured products is not imported as secondary lead, laboratory testing would be required and, even then, the results may be inconclusive as to whether the lead is primary or secondary lead. If the tax on primary lead imports cannot be successfully enforced, domestic primary lead supplies will be replaced by imported primary lead (and imported manufactured products containing primary lead) as well as by imports of secondary lead and lead scrap.

APPENDIX: PROPOSED FEDERAL LEGISLATION DIRECTED AT LEAD

(As of 9/23/91)

Introduced by 102d Congress

Bill	Summary	Status
H.R. 2922—Lead-Based Paint Hazard Abatement Act	A bill to amend the Public Health Service Act to establish an entitlement of States and certain political subdivisions of States to receive grants for the abatement of health hazards associated with lead-based paint, and to amend the Internal Revenue Code of 1986 to impose an excise tax and to establish a trust fund to satisfy the Federal obligations arising from such entitlement —Imposes a tax on lead removed from U.S. smelters and imported lead and lead products. Sets forth a tax of $0.75 per pound on primary lead; $0.37 per pound tax on secondary lead; exports would not be affected —Proposes to establish the Lead Abatement Trust Fund in the Treasury —Calls for establishment of a program of formula allotments to States and city and urban entities for abatement of lead-based paint hazards	Introduced 7/17/91; referred to House Committees on Energy and Commerce and Ways and Means.
S. 391—Lead Exposure Reduction Act of 1991	A bill to amend the Toxic Substances Control Act to reduce the levels of lead in the environment, and for other purposes —Proposes to prohibit the importing, manufacturing, processing, or distribution in commerce of certain products containing more than a specified percentage of lead. For instance, sets a maximum lead content (dry weight) of 0.06% for paint; 2% for plumbing fittings and fixtures; 0.1% for pesticides; 0.1% for toys and recreational game pieces; and 0.1% for curtain weights —Prohibits landfilling and/or incineration of lead-acid batteries	Introduced 2/07/91; referred to the Senate Environment and Public Works Committee; Subcommittee on Toxic Substances, Environmental Oversight, and Research and Development, amended and passed the bill; expected to reach Senate floor by the end of 1992.
H.R. 1750—Lead Exposure Reduction Act of 1991	Companion bill to S. 391	Introduced 4/11/91; referred to House Committee on Energy and Commerce.

H.R. 870—Lead Battery Recycling Incentives Act	A bill to amend the Solid Waste Disposal Act to provide management standards and recycling requirements for spent lead-acid batteries —A producer or importer of lead-acid batteries has to recycle a specific amount of spent lead generated from lead-acid batteries for a period of 10 years. The following formula has been proposed to determine the actual amount of lead to be recycled per year: First year recycling rate must be 80%, and each additional year for the following 10 years the recycling rate will be 2 percentage points higher than the previous year. If the recycling rate exceeds 95%, the Administrator may waive or reduce the 2% increase, which would otherwise be required for any year. The bill does establish other means for producers and importers to meet the mandatory recycling rate, such as the purchase of recycling "credits."	Introduced 2/06/91; referred to Committee on Energy and Commerce.
S. 398—Lead Battery Recycling Incentives Act	Companion bill to H.R. 870	Introduced 2/7/91; referred to Senate Committee on Environment and Public Works.

Introduced by 101st Congress

H.R. 5372—Lead Pollution Prevention Act of 1990	A bill to amend the Toxic Substances Control Act to reduce the levels of lead in the environment, and for other purposes	Introduced 7/25/90; referred to House Energy and Commerce Committee; no action.
S. 2892—Lead Battery Recycling Incentives Act	A bill to amend the Solid Waste Disposal Act to provide management standards and recycling requirements for spent lead-acid batteries	Introduced 7/24/90; referred to Senate Environment and Public Works Committee; no action.
H.R. 5359—Lead Battery Recycling Incentives Act	A bill to amend the Solid Waste Disposal Act to provide management standards and recycling requirements for spent lead-acid batteries	Introduced 7/24/90; referred to Committee on Energy and Commerce; no action.
S. 2637—Lead Exposure Reduction Act of 1990	A bill to amend the Toxic Substances Control Act to reduce the levels of lead in the environment, and for other purposes	Introduced 5/16/90; 9/90 with an amendment; referred to Senate Environment and Public Works Committee; on 10/18/90 reported to the Senate. Amended by the Senate Committee on Environment and Public Works; no action.

H.R. 3737—A bill to amend the Internal Revenue Code of 1986	A bill to amend the Internal Revenue Code of 1986 to impose an excise tax on certain uses of virgin materials and to establish a trust fund for recycling assistance and solid waste management planning —Proposed a tax of $2.50 per ton on virgin material consumed, tax was to increase to $7.50 per ton in 1991	Introduced 11/19/89; referred to Committees on House Energy and Commerce and House Ways and Means; no action.
H.R. 3735—Waste Materials Management Act of 1989	A bill to amend the Solid Waste Disposal Act to authorize appropriations for the fiscal years 1990 through 1993, and for other purposes	Introduced 11/19/89; approved for full committee action on 7/27/90 as amended by the House Energy and Commerce Committee, Subcommittee on Transportation and Hazardous Materials; no action.
H.R. 2853—Battery Recycling and Research Act of 1989	A bill to amend the Solid Waste Disposal Act to require the recycling of used lead-acid batteries, and to require a study by the Administrator of the Environmental Protection Agency on the disposal of used household dry-cell batteries	Introduced 7/11/89; referred to House Committee on Energy and Commerce; no action.
H.R. 2845—Recycling Promotion Act	A bill to amend the Solid Waste Disposal Act to promote recycling and other resource conservation approaches	Introduced 6/29/89; referred to the Committee on Energy and Commerce; no action.
S. 1113—Waste Minimization and Control Act of 1989	A bill to amend the Solid Waste Disposal Act and extend the authorization through 1993	Introduced 6/1/89; referred to the Senate Committee on Environment and Public Works, Subcommittee on Environmental Protection; no action.
S. 1112—Municipal Solid Waste Source Reduction and Recycling Act of 1989	A bill to amend the Solid Waste Disposal Act, and for other purposes —Section (109), which dealt with the recycling of lead-acid batteries, would have banned landfilling and incineration of such batteries	Introduced 6/1/89; referred to Committee on Environment and Public Works; no action.

*U.S.G.P.O.: 1993--708-008/80000

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