Chapter 1
Introduction

The 1980s were turbulent for the domestic nonferrous metals industries. Many mines and plants were closed-some temporarily, some permanently-for a variety of reasons including aging facilities, environmental regulations, and low metals prices. The corporate structures of the industries also changed drastically during the decade. Companies bought, sold, and merged businesses in order to become more competitive. This report profiles four domestic nonferrous metals industries (copper, aluminum, lead, and zinc) and the changes they have undergone since 1980.

SCOPE

The report focuses on the primary sectors of the four industries, little discussion is given to the secondary (recycling) sectors. Unless noted otherwise, prices, costs, and expenditures are in nominal (current) U.S. dollars, and global production and consumption figures refer to the nonsocialist world (NSW).1 All tonnage figures are in metric tomes (1 metric tonne= 1.1 short tons = 2,204.6 pounds). Companies are usually identified by their common abbreviations. Their full names, headquarters locations, major nonferrous metals affiliates, and principal countries of operation are listed in appendixes B and C.

BACKGROUND

The dominant feature of the nonferrous markets in the past decade was the global slowdown in demand growth. Following the oil shocks of the 1970s, metals use grew at much slower rates than had been common earlier in the post-war period (see figure l-l). Consumption growth rates declined several percentage points for each of the four metals in this study. The annual growth rates in NSW consumption during 1950-74 and 1979-88 were as follows:

	1950-74	*1979-88*
Copper	**3.9%**	**1.1%**
Aluminum	**9.0%**	**2.3%**
Lead	**2.7%**	**0.5%**
Zinc	**3.9%**	**1.2%**

This long-term (secular) slowdown affected metals producers worldwide not just in the United States.

U.S. metals producers faced other challenges, in addition to the demand slowdown, during the 1980s. In some cases, these problems had their beginnings 20 or 30 years prior. Since World War II, the United States has seen its dominance in the production of many nonferrous metals diminish greatly. In 1950, almost half of the NSW'S output of refined copper, aluminum, and zinc, and over a quarter of its lead came from the United States.[2] The dominance of U.S. companies was made even greater by their many foreign affiliates. By 1980, the U.S. share for refined metal production had declined to 24 percent for copper, 36 percent for aluminum, and 8 percent for zinc. The U.S. share of the lead market increased to 28 percent, because of the opening of the Viburnum Trend in Missouri.

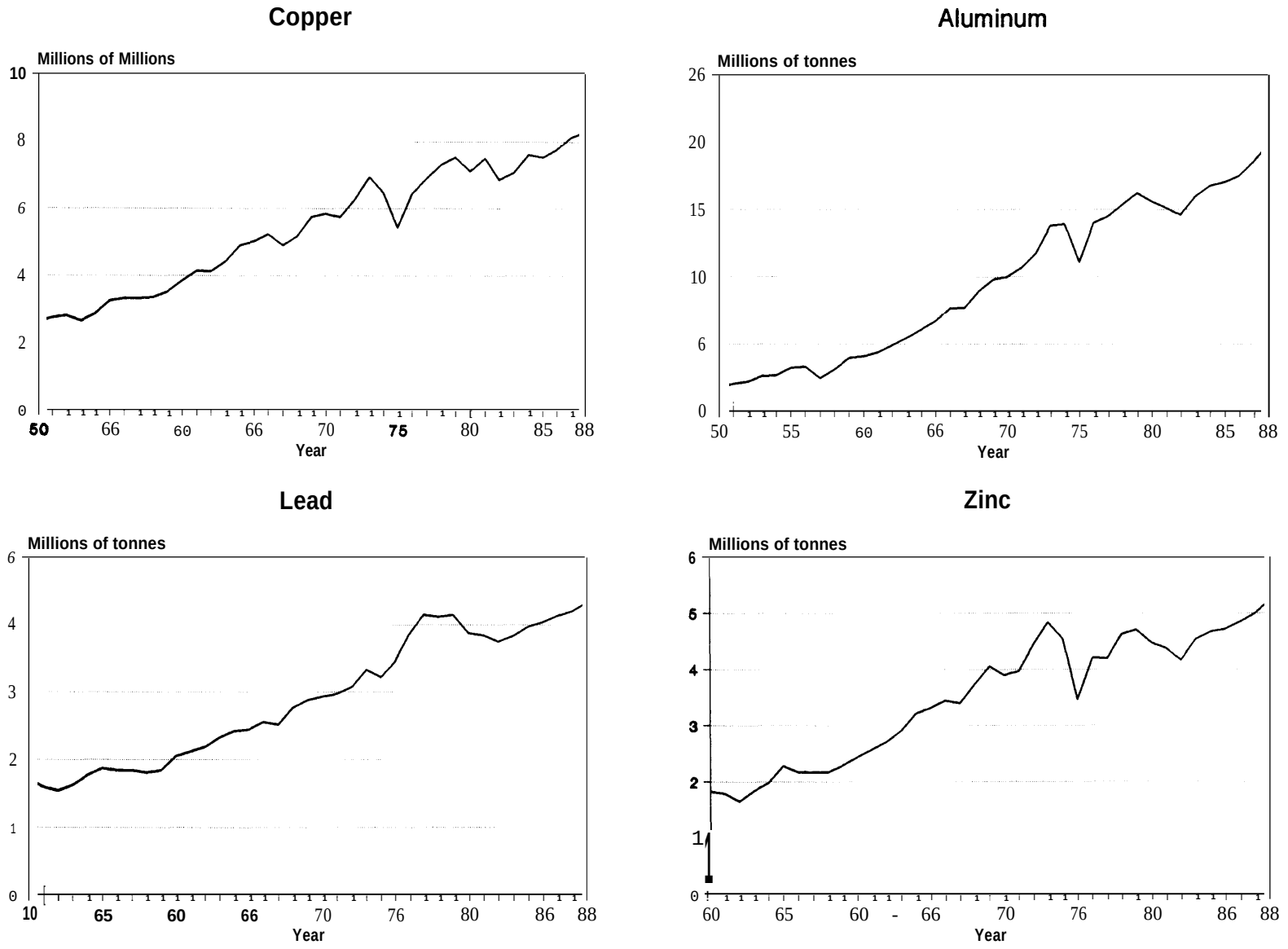
Production grew overseas faster than in the United States for a variety of reasons. New deposits were discovered in relatively unexplored foreign regions (e.g., Australia and Brazil). Processing plants were built overseas to keep costs low, to fiulfill countries' development plans, and to be near growing markets. For example, the development of abundant low-cost power lured aluminum~ production to Australia, Canada, Brazil, and Venezuela. The rebuilding of the war torn countries, and the general economic development of others, caused the overseas markets for metals to grew faster than the North American market.[3]

[1]The NSW comprises all countries with market economies (including Yugoslavia). It excludes the Centrally Planned Economies: Albania, Bulgaria, China, Cub% Czechoslovakia, East Germany, Hungary, Kampuchea, North Korea, Laos, Mongolia, Poland, Romania, the Soviet Union (U.S.S.R.), and Vietnam.

[2]Tables showing the largest NSW mine and metal producing nations in 1950, 1960, 1970, 1980, and 1988 appear in app. A.

[3]These countries did not all, however, become large end-users of the metal they consumed. Their metals fabrication sectors (the principal markets for metals) were developed for the purpose of making products for both domestic use and export.

Figure I-1-Nonsocialist World Consumption of Copper, Aluminum, bad, and Zinc, 1950-88



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U.S. dominance was also weakened by the iiagrnentation of the metals markets. Many companies independent of U.S.-based multinationals began producing nonferrous metals. Among these were State-owned operations and custom smelters/refiners.[4] These companies complicate the markets because they have goals that often diverge from those of the traditional integrated producers. The industry was also shaken up by the entrance of non-mining firms (e.g., oil companies).

There was also direct market intervention (stockpile transactions and price controls) taken by the U.S. Government. Such actions, along with the establishment of floating exchange rates, caused metals prices to become more volatile. This made planning more difficult and the business generally more risky.

High production costs also plagued the U.S. industry. In the copper and zinc industries, the United States was in danger of becoming a marginal producer. Labor, energy, and environmental compliance costs increased during the 1970s especially. Productivity at U.S. mines and plants had not increased enough to offset the increased costs. Domestic facilities were mostly older and in great need of modernization.

COPPER

The United States is currently the NSW'S largest copper refiner, and second largest miner and primary smelter. Most of the production comes from Arizona, New Mexico, Utah, Michigan, and Montana. The principal foreign competitors are in less developed countries (Chile, Zambia, Zaire, and Peru). Except in Peru, the largest companies in these countries are state-owned.

In the 1980s, the domestic copper industry experienced many difficult years when prices and production levels were both low. Prices ranged from $0.66 to $0.77flb during 1982-86. U.S. primary copper production remained in the 1.0 to 1.2 million tonnes per year (tpy) range during 1982-87. The market began recovering in 1987. In 1989, prices rose to $1.31/lb and production increased to 1.5 million tonnes. The production levels at the end of the 1980s were comparable to those of the late 1970s, except in the smelting sector which had declined signicantly (see table l-l). Over the 1979-89 period, production was up 4 percent at mines, down 16 percent at smelters, down 3 percent at primary refineries, and up 7 percent at secondary plants. In comparison, production elsewhere in the NSW increased between 13 and 20 percent in the various primary sectors and 41 percent in the secondary sector during 1979-88 (see table 1-2).

Four major new domestic copper-producing mines opened during the decade (see table l-l). Five mines closed permanently and many more were closed temporarily because of low prices, strikes, and modernization shutdowns. From March 1981 to January 1983,28 domestic mines closed or cut back production and U.S. mine capacity utilization hovered around 65 percent.[5] In the processing sector, five smelters and three refineries (electrolytic and fire refineries) closed permanently. No greenfield plants opened, but several existing facilities underwent substantial modernization.[6] Environmental regulations and aging facilities were major causes of the decline in this sector. The picture was more positive in the electrowinning sector, seven facilities opened, five closed, and many were expanded.

The number of companies involved in the U.S. copper industry declined during the 1980s. Large producers such as Anaconda Copper, Amax, Duval, Inspiration, Cities Service, and Noranda left the industry while only Montana Resources and Cox Creek Refining entered. Major changes occurred in the ownership of severaI of the major producers. Cyprus was spun off from Amoco in 1985. Magma was spun off from Newmont in 1987. Copper Range changed hands several times before it was bought by Metall Mining (a Canadian subsidiary of Metallgesellschaft) in 1989. Kemecott was acquired by SOHIO (a subsidiary of British Petroleum) in 1981 and then sold to London-based RTZ (the world's largest minerals firm) in 1989.

Five companies (Phelps Dodge, Magma, Cyprus, Kemecott, and Asarco) currently account for most of the primary copper production in the United

[4]Custom smelters/refiners process concentrates (or other intermediate materials) produced by other companies. The feed material is either bought or tolled. In the case of tolling, the material is processed for a fee, but does not change ownership.

[5]U.S. Congress, Office of Technology Assessment, *Copper: Technology and Competitiveness, OTA-E-367* (Washington DC: U.S. Government Printing Office, September 1988).

[6]There is, however, talk of building a new copper smelter in Texas.

Table I-l—Profile of U.S. Nonferrous Metals Industries, 1989 and 1990

Production and consumption in thousands of metric tonnes[a] (preliminary statistics)	Copper 1989	Copper Change from 1979	Aluminum 1989	Aluminum Change from 1979	Lead 1989	Lead Change from 1979	Zinc 1989	Zinc Change from 1979
Mine production	1,498	4%			408	–24%	278	–5%
	(smelter)		(refinery)					
Intermediate metal production	1,120	–16%	NA	NA	—	—	—	—
Primary metal production	1,477	-3%	4,030	–1 2%	396	-31%	251	4 7 %
Secondary production	477[c]	4%	1 ,931d	20%	790'	– 2%	11Oc	107Y0
Metal consumption	2,184	1%	NA	NA	1,228	–9%	1,063	IYO
Number of facilities operating 1990 and number opened/closed 1980-90°	1990	Change 1980-90	1990	Change 1980-90	1990	Change 1980-90	1990	Change 1980-90
Major mines	25	4/5	-_[b]	a	17	6/2	22	7/5
Smelters	8	0/8	6	0/3	4	0/2	4	0/3
	(electrolytic)							
Refineries			23	0/10	4	0/1	—	—
	(electrowinning)							

NOTES:
[a]SOURCES: U.S. Department of the Interior, Bureau of Mines, *Mineral Commodity Summaries 1990* and *Mineral Industry Surveys* (Washington, DC).
bus. production of metallurgical-grade bauxite is small.
[c]Refined metal recovered from Okt and new scrap.
[d]All products (metal, chemicals, etc.) recovered from old and new scrap.
[e]SOURCE: U.S. Department of the Interior, Bureau of Mines, *Minerals Yearbook* (Washington, DC), various issues.

Table 1-2—Profile of U.S. and Nonsocialist World Nonferrous Metals Industries, 1988

Production and consumption in thousands of metric tonnes	Copper 1988	Copper Change from 1979	Aluminum 1988	Aluminum Change from 1979	Lead 1988	Lead Change from 1979	Zinc 1988	Zinc Change from 1979
Mine production:								
United States	1,420	–2%	588	-68%	394	*–27%*	256	–13%
Rest of nonsocialist world	5,283	13%	86,891	1570	1,930	*-4%*	4,842	1170
Nonsocialist world	6,702	9%	87,479	13%	2,324	*–9%*	5,098	10940
Intermediate metal production:	(smelter)		(refinery)					
United States	1,043	*–22%0*	*5,105*	*–23%*	—	—	—	—
Rest of nonsocialist world	5,372	15%	26,277	28%	—	—	—	—
Nonsocialist world	6,415	7%	31,382	15%	—	—	—	—
Primary metal production:								
United States	1,406	*–7%*	*3,944*	–13%	392	–32%	241	*-49%*
Rest of nonsocialist world	5,179	*20%*	*9,909*	*3470*	1,861	2%	4,548	18%
Nonsocialist world	6,585	13%	13,852	16%	2,253	–6%	4,790	1O%
Secondary production:								
United States	453a	–1%	2,1 22b	32%	737a	–9%	89[a]	66%
Rest of nonsocialist world	1,003a	41%	3,275[b]	46%.	1,569a	1 1%	345'	9%
Nonsocialist world	1,456a	24%	5,397b	40%	2,306[a]	4%	434"	1770
Metal consumption:								
United States	2,214	2%	6,720	1 %	1,236	–8%	1,089	3%
Rest of nonsocialist world	6,051	13%	13,122	37%	3,090	11%	4,146	14%
Nonsocialist world	8,265	10%	19,842	23%	4,326	4%	5,235	11%

a Refined metal recovered from old and new Wrap.
[b]All products (metal, *chemicals,* etc.) recovered from old and new scrap.
SOURCE: *Metal Statistics 1978-1988,* Metallgesellschaft Aktiengesellschaft.

States. They are integrated producers that have been producing copper for many years. Most of their mines, smelters, and refineries are in the United States. Their strategies generally emphasize low-cost production and, except for Asarco, specialization in copper rather than broad-based minerals activities.[7] Over the last decade, these companies cut their costs drastically. Some of the measures (e.g., delayed maintenance) yielded short-term cost gains, but many resulted in permanent savings. Wage rates were renegotiated, and in some cases tied to metals prices. The number of workers was also cut. In addition, a great amount of money was invested to modernize mines and plants. As a result, the domestic industry is now relatively cost competitive and among the world's most modern. It is the leader in the use of low-cost solvent extraction-electrowinning (SX-EW) technology.

Little of the recent U.S. investment has gone into either exploration or research and development (R&D). Exploration has been limited because of the financial risk of building new mines, especially when several large new projects (e.g., Olympic Dam in Australia and Neves Corvo in Portugal) have recently come on stream and several others are expected soon (e.g., La Escondida in Chile and Salobo in Brazil). R&D efforts are also minimal. The general feeling is that technology transfers too quickly in the industry to allow any particular company to make exclusive gains from R&D. The problem is particularly acute in the area of product development. Little attention is paid to product differentiation. Copper is seen basically as a commodity, with consumers basing their purchase decisions almost solely on price.

Acid rain legislation tops the list of the industry's environmental concerns. U.S. copper producers feel they contribute little to overall sulfur dioxide (SO_2) emissions, and the associated acid rain, and therefore should not be subjected to more stringent regulations. They also argue that they have already invested greatly to reduce their SO_2 emissions under legislation enacted in the 1970s. Producers are also concerned about increases in energy costs that would result from energy utilities' compliance with potential regulations in this area.

ALUMINUM

The United States mines little bauxite, but is currently the NSW's second largest alumina refiner and largest aluminum smelter.[8] Except for one plant in the Virgin Islands, all of the domestic alumina refineries are located near the Gulf Coast. The smelter capacity is located primarily in the Pacific Northwest and the Ohio Valley, but also in the Carolinas, New York, and Texas. The major foreign producers are in Western Europe, Canada, Australia, Brazil, and Venezuela. Most of the industry's new capacity is being built in the latter four countries, because of their abundant, low-priced electricity. The cost and availability of electricity, which accounts for about one-third of primary aluminum production costs, are principal factors in the siting of new smelters and the competitiveness of existing smelters.[9]

The U.S. aluminum market went through several cycles during the decade. Prices fluctuated between $0.47/lb and $0.76/lb in the 1980-87 period, but ended the decade somewhat higher ($1.10/lb in 1988 and $0.89/lb in 1989). U.S. primary aluminum production fell as low as 3.0 million tpy (in 1986), but recovered to around 4.0 million tpy in 1988-89. Primary production in 1989 was 12 percent lower than that in 1979. Secondary production, however, was up 20 percent over the same period. In other NSW countries, primary aluminum production increased 34 percent and secondary production increased 46 percent during 1979-88.

During the decade, four alumina refineries and ten aluminum smelters closed. More smelters were closed temporarily at various times, because of low prices. The only new facility to open was the Mount Holly, South Carolina smelter which began production in 1980.

Three companies (Conalco, Anaconda Aluminum, and Revere Copper and Brass) left the U.S. industry during the 1980s. A fourth, Martin Marietta sold one of its smelters and leased the other to an

[7]Gary A. Campbell, "The Response of U.S. Copper Companies to Changing Market Conditions," *Resources Policy,* vol. 15, No. 4, December 1989, pp. 320-336.

[8]This report does not cover the U.S. bauxite mining sector. Most domestic bauxite goes for nonmetallurgical uses such as abrasives, chemicals, proppants, refractories, or specialty aluminas.

[9]Merton Peck (cd.), *The World Aluminum Industry in a Changing Energy Era* (Washington, DC: Resources for the Future, 1988).

independent producer. Six companies (Columbia Aluminum, Columbia Falls, Alcan, Vanalco, Ravenswood, and Northwest Aluminum) entered U.S. industry in the 1980s. A seventh (Ornet) was essentially new to the industry also. It was sold to its current owners, Ohio River Associates, in 1986.

The "U.S. majors" (Alcoa, Reynolds, Alumax, and Kaiser) operate almost two-thirds of U.S. smelter capacity. They are multinationals with aluminum smelters and fabricating plants all over the world. Except for Alumax, they all own bauxite mines and alumina refineries. Most of these companies' recent investment in the primary aluminum sector have been in overseas facilities. For example, Alcoa is investing in Australia, and Reynolds and Alumax are spending in Canada. In the United States, they are emphasizing the fabricating end of the business (cans, foil, packaging, architectural products, etc.).[10] All four companies invest heavily in R&D for these more value-added products.

The remaining one-third of U.S. aluminum smelter capacity is operated by two Canadian firms and seven 'independents. The Canada-based firms are Alcan and Noranda. The independents are Ormet, Southwire, Columbia Aluminum, Columbia Falls, Vanalco, Ravenswood, and Northwest Aluminum. Except for Southwire, all were formed in the 1980s.

Recycling is an important factor in the U.S. aluminum industry. The production of secondary aluminum consumes about 90 to 95 percent less energy than does primary aluminum. About 60 percent of secondary aluminum recovered from old scrap comes from used beverage containers (UBC). In 1988, the UBC recycling rate was about 55 percent in the United States. Most UBC is recycled by aluminum sheet producers, many of which are also primary aluminum companies. Industrial scrap is processed by secondary smelters. About 40 secondary aluminum producers are in operation in the United States.

Acid rain legislation, because of its effects on the electric utilities, is the principal environmental concern of the aluminum industry. All proposed SO_2 emissions regulations will raise costs at coal-based utilities to some degree. The extent to which the cost increases will be passed on to aluminum smelters is uncertain. The impact will be mitigated somewhat by the variable rate contracts that tie electricity rates to the price of aluminum. A U.S. Bureau of Mines study of 10 domestic smelters found that the various acid rain proposals would increase their electricity rates by 3.5 to 5.5 mills/kWh and increase their costs by an estimated 2.5 to 4¢/lb of aluminum.[11] The increases, however, are very site-specific. In Ohio and West Virginia, costs would increase *5.2* to 7.7¢/lb; in other regions, the effects would be smaller. Smelters tied to hydropower utilities would see minimal rate increases. The 10 smelters studied account for 90 percent of the aluminum capacity that is tied to coal-fried generating facilities-those most liable to experience cost increases from acid rain legislation.[12] They account for about half of domestic aluminum capacity overall.

LEAD

The United States is a major producer of lead. It currently ranks second in the NSW in mine output and first in refined lead production. The principal mines and plants are in southeastern Missouri's Viburnum Trend. There are additional lead-producing mines in Colorado, Idaho, Montana, and Alaska, and processing facilities in Montana and Nebraska. The main integrated foreign competitors are Australia, Canada, and Mexico. In addition, Peru is a major mining country, and Western European countries and Japan have large processing sectors.

The U.S. lead industry faced hard times in the mid-1980s. Lead prices started the decade at around $0.43/lb, fluctuated downward to $0.19/lb in 1985, and then recovered to the $0.35 to $0.49/lb range in 1987-89. Production of primary lead declined over the decade. During 1979-89, U.S. mine production declined 24 percent and primary metal production fell 31 percent. Secondary production declined in the early 1980s, but rose later in the decade to nearly match its 1979 level. In other nonsocialist countries,

[10] The majors have not, however, abandoned all of their domestic primary aluminum capacity. It helps them manage their business risk.

[11] The smelters studied were Sebree, KY (Alcan); Frederick, MD (Alumax); Mt. Holly, SC (Alumax); Badin, NC (Alcoa); Evansville, IN (Alcoa); Rockdale, TX (Alcoa); Hawesville, KY (Southwire); New Madrid, MO (Noranda): Hannibal, OH (Ormet); and Ravenswood, WV (Ravenswood). John B. Bennett, *The Potential Impact of Acid Rain Legislation on the Domestic Aluminum Industry, OFR* 58-88 (Washington, DC: U.S. Department of the Interior, Bureau of Mines, October 1988).

[12] U.S. Congress, Congressional Research Service, *Acid Rain Legislation and the Domestic Aluminum Industry,* CRS Report for Congress, 89-327 ENR, May 1989.

primary production held fairly steady and secondary production rose 11 percent during 1979-88.

Six new lead-producing mines opened during the decade.[13] Two mines that produced lead were permanently closed. Many more mines closed temporarily at some time during the 1980s, because of low prices. In the processing sector, two smelters and one refinery were closed permanently and no new ones opened.

Much of the U.S. primary lead industry changed ownership during the 1980s. Ten firms (Doe Run, Asarco, Cominco-Dresser, Montana Tunnels, Greens Creek, Washington Mining, Hecla, Bunker Hill Mining, Star-Phoenix Mining, and New Butte Mining) currently mine lead in the United States. Only Doe Run and Asarco operate smelting/refining facilities.

Cominco-Alaska will operate the new Red Dog zinc-lead mine in Alaska. The mine is slated to open in 1990. The project is a joint venture between Cominco (a Canada-based multinational minerals producer) and NANA (an Alaskan Native corporation) which owns the mineral rights to the property. Red Dog is being developed primarily for its zinc. However, at full capacity it will be the United States' third or fourth largest lead-producing mine and will increase domestic production by 16 percent over 1989 levels. The mine will ship its concentrates to British Columbia, the Far East, and Europe for processing.

Lead's health effects are the industry's most important environmental issue. Health concerns have weakened demand for the metal in some sectors (e.g., gasoline additives, indoor paints, and various building products). There is also concern regarding the health and safety of workers exposed to lead particulate during the production process. Most of the industry is not in compliance with the current National Ambient Air Quality Standards (NAAQS) particulate standard for lead.[14]

Compared with other metals industries, lead has a relatively easy time meeting the SO_2 emissions standards of the Clean Air Act. The economics of sulfur recovery are further aided by existence of large nearby sulfuric acid markets. However, one of the four existing primary smelters does not have an acid plant, and could be forced to close in the not-too-distant future under contemplated regulations.

Currently, about 65 percent of U.S. refinery output is secondary lead. Lead acid batteries account for 85 percent of total recycled lead material at domestic secondary plants. The major secondary smelters in the United States are RSR Corp., Pacific Dunlop/GNB Battery, Schuylkill Metals, Exide Corp. Battery, and Sanders Lead, which represent over 70 percent of domestic capacity. Environmental factors caused recycling to become more difficult in the 1980s. Spent lead batteries are classified by the U.S. Environmental Protection Agency (EPA) as hazardous waste under the Resource Conservation and Recovery Act (RCRA). Many scrap collectors and dealers refuse to handle batteries for fear of incurring liability under Superfund.[15] However, the integrated metal producers, battery manufacturers, and large independent smelters have backward integrated into this market segment to a large degree.

ZINC

The United States is a relatively small zinc producer. In the NSW, it ranks sixth in mine production, eighth in primary refinery production, and first in secondary output. The principal zinc mining State is Tennessee. It accounts for over half of U.S. production. Additional zinc-producing mines are located in Missouri, Colorado, Alaska, Idaho, Montana, New York, and Nevada. About 20 percent of total zinc production comes as a byproduct of Missouri lead mines, but most comes from mines where lead is of minor importance. Processing facilities are located in Tennessee, Pennsylvania, Oklahoma, and Illinois. The main foreign integrated producers are Canada, Australia, and Western European countries. In addition, Peru and Mexico are major mining countries, and Japan has a large processing sector. The major area for new primary zinc capacity is Australia.

[13] This includes the Red Dog zinc-lead mine, slated to begin full production in 1990.

[14] Raymond J. Isherwood et al., *The Impact of Existing and Proposed Regulations Upon the Domestic Lead Industry*, OFR 55-88 (Washington, DC: U.S. Department of the Interior, Bureau of Mines, 1988).

[15] Superfund is the common name for the Comprehensive Environmental Response, compensation, and Liability Act.

Zinc prices, unlike those of copper, aluminum, and lead, fluctuated upward during the 1980s. The price of zinc remained above its 1980 level of $0.36/lb for the entire decade. Prices rose their greatest in the later years, when they increased from $0.38/lb (1986) to $0.82/lb (1989). U.S. secondary production rose during the decade, but primary output fell. Compared with 1979 levels, U.S. production in 1989 was down 5 percent in mining, down 47 percent in primary slab processing, and up 107 percent in secondary slab processing. In other nonsocialist countries, production increased 11, 18, and 9 percent in the mining, primary slab, and secondary slab sectors respectively during 1979-88.

In the United States, one new zinc mine (Pierrepont) and two zinc-producing precious metals mines (Greens Creek and Montana Tunnels) opened during the decade. In addition, zinc is recovered from the West Fork lead mine which opened in 1985. Five zinc mines, and one zinc-producing precious metals mine, were permanently closed during the 1980s. In the processing sector, three smelter/refineries were closed permanently and no new ones opened.

As in the lead industry, much of the U.S. zinc industry changed ownership during the 1980s. Fourteen firms (Zinc Corp. of America, Jersey Miniere, Big River, Asarco, Alta Gold, Cominco-Dresser, Doe Run, Montana Tunnels, Greens Creek, Hecla, Washington Mining, Bunker Hill Mining, Star-Phoenix Mining, and New Butte Mining) currently produce primary zinc in the United States. Only the first three operate primary smelting/refining zinc facilities. All but Big River operate mines.

When it opens in 1990, the Cominco-NANA Red Dog mine will greatly boost the United States' stature as a zinc producer. At capacity, it will be the world's largest zinc mine and nearly double U.S. zinc mine production over 1989 levels.

The decline in the U.S. zinc industry during the last two decades has been more pronounced than in the copper, aluminum, and lead industries. Primary slab zinc capacity fell from 980,000 tomes in 1970 to 570,000 tonnes in 1980 to 320,000 tomes in 1988. The closures were the result of declining local supplies of concentrates, rising energy (primarily natural gas) costs , and environmental regulations.[16]

Compliance with environmental regulations does not appear to constitute a major competitive disadvantage to current U.S. producers .17 Of the four primary slab plants that remain, three are electrolytic plants which are relatively easy to modify to meet environmental standards.

[16]Gary A. Campbell, Anil Jambekar, and Brian Frame, "Zinc Processing in the USA: An Analysis of a Declining Industry," *Resources Policy, vol.* 12, No. 4, December 1986, pp. 317-334.

[17]U.S. Congress, Congressional Research Service, *The Competitiveness of American Mining and Processing*, report prepared for tie House Committee on Energy and Commerce, Subcommittee on Oversight and Investigations, Committee Print 99-FF (Washington, DC: U.S. Government Printing Office, July 1986).