Lead

John Keating

The author is with the Mining Sector,
Natural Resources Canada.
Telephone: (613) 992-4409

According to preliminary figures from the International Lead and Zinc Study Group (ILZSG), Western World lead consumption increased for the second consecutive year to 4 731 000 t in 1994, a 5% increase over 1993. Mine and metal production of lead both rose marginally by 0.8% to 2 013 000 t and 4 471 000 t, respectively.

Total refined metal stocks continued to rise early in the year to a month-end high of 858 900 t in May, but began to fall in the second half, mainly due to a decline in producer stocks. However, stocks on the London Metal Exchange (LME) continued to rise into the fourth quarter to a record 370 000 t in October, before falling to 343 400 t at year-end.

CANADIAN DEVELOPMENTS

Canadian mine production of lead in 1994 totalled 166 400 t, compared to 183 100 t in 1993. The decrease was primarily due to closures and production cuts that occurred in 1993 and 1994 in response to low lead prices.

Lead metal production in 1994 totalled 243 000 t, an increase of 26 000 t from 1993. The growth was partly a result of greater secondary output and a return to more normal production levels for primary smelters.

British Columbia

Cominco Ltd. announced it would replace its inoperative QSL lead smelter with Russian Kivcet technology at its Trail metallurgical complex. The 160 000-t/y QSL smelter began operation in December 1989, but closed in March 1990 due to design and mechanical problems. Attempts to correct the problem by the German manufacturer Lurgi Gmbh were unsuccessful. The new 120 000-t/y Kivcet smelter is expected to treat residues from zinc refining operations and scrap lead material along with lead concentrate. It is estimated that over C$160 million has been spent on the QSL technology and that capital expenditures for the Kivcet process will be about C$145 million. The company will maintain production from its conventional 136 000-t/y sinter and blast furnace smelter until the QSL smelter is dismantled and the new smelter comes on stream in 1996.

Redfern Resources Ltd. began permitting and final feasibility studies of its Tulsequah Chief lead-zinc deposit located 100 km south of Atlin. The deposit was last mined by Cominco in the 1950s, before low metal prices forced its closure. Redfern acquired 100% ownership from Cominco in 1992 and has spent C$12 million in exploration and development. A prefeasibility study estimates geological reserves at 8.5 Mt grading 1.17% lead, 6.85% zinc, 1.48% copper, 2.56 g/t gold, and 103.42 g/t silver.

In February, Cominco (50%) and Teck Corporation (50%) purchased the currently closed Sa Dena Hes mine and undeveloped Cirque property for C$35 million from the receiver responsible for the assets of Curragh Inc. Each company has subsequently sold a 50% interest in the properties to Korea Zinc Co., Ltd. The Cirque lead-zinc deposit (formerly Stronsay) near Mackenzie received a mine development certificate from the B.C. government in 1991. At that time, it was reported that the property could produce 28 000 t/y of lead in concentrate with a mine life of 20 years, and it had reserves of 52 Mt averaging 2% lead, 8% zinc and 42 g/t silver.

Yukon

Anvil Range Mining Corporation purchased the Faro lead-zinc operation for C$27 million from receiver KMPG Peat Marwick Thorne Inc. after raising C$120 million through share placements. Production was suspended in March 1993 after former owner Curragh was placed into receivership. The Faro mill is expected to re-open during the second half of 1995 once stripping of the Grum deposit is completed. Prior to the closure, the 13 500-t/d mill typically produced 105 000 t/y of lead, 150 000 t/y of zinc, and 125 t/y of silver, all in concentrate.

Cominco discovered a new polymetallic massive sulphide zone on its Tag property located 200 km northwest of Watson Lake and close to the Robert

Campbell highway. Drilling has identified an inferred resource of 13 Mt grading 1.3% lead, 5.5% zinc, 1% copper, 125 g/t silver, and 1.2 g/t gold, half of which may be amenable to open-pit mining. The company is also reported to be fast-tracking the property, which could be brought on stream at an estimated cost of C$100 million with a mine life of 12 years.

Northwest Territories

San Andreas Resources continued exploration of its Prairie Creek lead-zinc property in the Nahanni River area, 500 km west of Yellowknife. Current estimated reserves are 3.9 Mt grading 13% lead, 14.6% zinc, and 202 g/t silver. A full feasibility study is scheduled for completion in the spring of 1995.

Quebec

Nova Pb completed construction of Phase 1 of a multi-layer monofil slag storage facility. Storm water run-off from the leak-proof site will be processed in the company's water treatment plant. Up to 35 000 t of slag can be stored on the current site with a plan to increase capacity to 45 000 t in four to five years as part of Phase 2. This will provide the company with the capability to store slag for 40 years. However, the site may never be filled to capacity because Nova Pb is researching environmentally safe opportunities to re-use the material.

New Brunswick

Brunswick Mining and Smelting Corporation Limited (BM&S) re-opened the 72 000-t/y Belledune lead smelter on January 3 after it had been closed for six weeks due to insufficient concentrate supply. On June 10, the operation was again temporarily suspended for six weeks for maintenance.

The Heath Steele mine was re-opened by BM&S on October 11. Production was suspended in July 1993 because of poor metal prices. The mine has a rated capacity of 11 000 t/y of lead in concentrate. It was also reported that lead concentrate and bulk lead-zinc concentrate output increased in 1994 at the company's Brunswick mine due in part to higher recovery rates.

WORLD DEVELOPMENTS

Western World mine production of lead rose to 2 013 000 t in 1994 from 1 998 000 t in 1993. An increase of 28% in Mexico and 7% in Europe more than offset minor reductions in output from most other countries. Nine mines re-opened, expanded production or came on stream in 1994, while six mines closed or suspended operations because of ore depletion or weak metal prices. The result was a net decline of 43 200 t in total capacity.

Western World refined lead production in 1994 was 4 471 000 t, an increase of 34 t from 1993. Secondary production is expected to have surpassed primary output as a result of a tightness in concentrate availability and regional increases in scrap supply as evidenced by strong growth in replacement battery demand in North America. In addition, a significant number of primary smelters in countries that are members of the Organization for Economic Co-operation and Development (OECD) converted to, or increased the throughput of, secondary materials during 1994.

Primary Production

Asia/Oceania

In Australia, MIM Holdings Ltd. (70%) and a Japanese consortium (30%) continued development of the US$165 million McArthur River lead-zinc mine in the Northern Territory. The new mine is scheduled to open in 1995 and will, at full capacity, produce a bulk concentrate yielding 45 000 t/y of lead in concentrate. The McArthur River orebody contains proven reserves of 227 Mt grading 9.2% zinc, 4.1% lead, and 41 g/t silver.

Additional drilling at BHP's Cannington deposit has outlined proven, indicated and inferred reserves reported at 45.3 Mt averaging 11.1% lead, 4.4% zinc, and 500 g/t silver. According to feasibility studies, a mine could be developed that would produce 215 000 t/y of lead in concentrate and 135 000 t/y of zinc in concentrate.

A native land claim dispute could delay the commencement of CRA's Century deposit in Queensland, which is scheduled to come on stream in 1997/98. It is expected that the mine will produce 55 000 t/y of lead in concentrate.

In China, the first stage of the Changba zinc-lead mine opened in early 1994 with a rated capacity of 1800 t/y of lead in concentrate. Output is expected to increase to 5000 t/y with the completion of the second stage in 1996.

In the Yunnan province, development of the large open-pit Lanping zinc-lead mine continued with expected start-up in 1995. Although predominantly a zinc project, the new mine will have a capacity of 5000 t/y of lead in concentrate.

A shortage of concentrates restricted output of refined lead from Korea Zinc. However, production is expected to increase by 20 000 t to 100 000 t in 1995 as the concentrate market improves.

In Japan, low lead prices, a strong yen, rising imports, and a drop in domestic battery demand were reported to be responsible for the closure of Mitsubishi Materials Corporation's 42 000-t/y Naoshima primary lead smelter and new electrolytic refinery,

and also the Saganoseki 36 000-t/y primary lead electrolytic refinery owned by Nippon Mining and Metals.

Mitsui Mining and Smelting Co. Ltd. and Mitsubishi Materials Corporation announced that they will stop using concentrates and source only scrap lead material as feed for their respective 34 000-t/y Kamioka and 22 000-t/y Hosokura smelters.

Americas

The U.S. Defense Logistics Agency (DLA) disposed of slightly under 32 000 t of lead from its strategic stockpile in fiscal year 1994 which ended September 30. This was the authorized amount in the Annual Materials Plan. The DLA is authorized to dispose of about 68 000 t under the fiscal year 1995 plan.

In August, Hecla Mining Company temporarily closed its Lucky Friday lead-zinc-silver mine in Idaho after an accident at one of the mine shafts. The mine, which opened in 1950, has a typical annual production of 29 000 t of lead, 4000 t of zinc, and 135 t of silver.

Fluor Corporation sold its wholly owned subsidiary, The Doe Run Co., to Renco. Doe Run is the largest lead producer in the United States with a 210 000-t/y primary smelter in Herculaneum and a 70 000-t/y secondary smelter in Buick, Missouri.

Also in Missouri, the Magmont mine owned by Cominco American Incorporated and Dresser Industries Inc. closed permanently because of ore exhaustion in June. The underground operation had a rated capacity of 80 000 t/y of lead and 18 000 t/y of zinc in concentrate.

In Mexico, the Tizapa mine owned by Met-Mex Penoles Sa de CV and Dowa Mining Co. Ltd. opened in mid-1994 and is expected to produce 3000 t/y of lead in concentrate. Penoles also brought the La Cienga gold mine on stream, which will produce 2300 t/y of lead in concentrate as a by-product.

Europe

Metaleurop S.A. temporarily closed its Noyelles Godault and Nordenham lead plants during the summer because of concentrate shortages. The total loss in lead output was reported at 30 000-35 000 t. The company also announced it would invest US$43 million to replace its 95 000-t/y Nordenham shaft furnace with a 90 000-t/y Isasmelt plant that can process a higher proportion of secondary material. It was reported that some of the scrap feed would be excess battery paste from the company's Oker secondary lead smelter, where output has been reduced by almost 50%.

Metallgesellschaft AG (MG) and MIM agreed to restructure their German smelting interests so that MIM will own 100% of MHD "Berzelius" Duisburg GmbH, which operates a 45 000-t/y lead capacity ISF (Imperial Smelting Furnace) plant in Duisburg. This transaction, combined with MIM's 1993 acquisition of the 55 000-t/y lead capacity ISF plant in Avonmouth in the United Kingdom, will likely provide the company with the smelting capacity to process fine-grained lead-zinc ores from the company's McArthur River deposit in Australia.

It was also reported that MG's Stolberg QSL smelter will process more scrap material and cut production by 22% to 70 000 t/y of lead as the plant moves from a seven-day to a five-day week. In addition, the company's Braubach secondary lead smelter cut output from 40 000 t/y to 20 000 t/y with a plan to ship excess battery scrap to the Stolberg plant.

Scrap material reportedly accounts for 50% of the feed at Nuova Samim SpA's Kivcet lead smelter in Porto Vesme, Italy. It was also reported that the company may process more scrap material at its ISF smelter in Porto Vesme and expand capacity from 32 000 t/y to 40 000 t/y of lead.

In Spain, the Aznalcollar lead-zinc-copper mine owned by Andaluza de Piritas S.A. (Apirsa) was re-opened in July. Production at the open-pit operation, with a rated capacity of 20 000 t/y of lead in concentrate, was suspended in May 1993 because of a prolonged drought. The company plans to bring the new Los Frailes open-pit mine on stream in 1996, raising capacity by 30 000 t/y to 50 000 t/y of lead in concentrate.

Africa

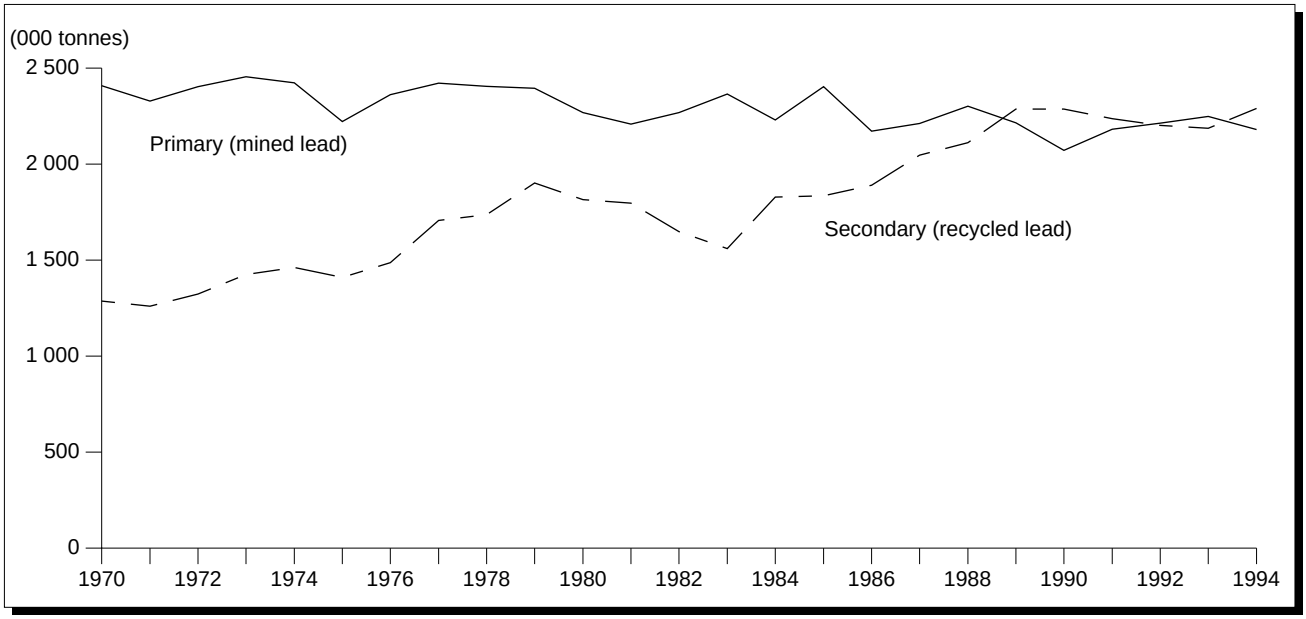
In Tunisia, Société Minière de Bougrine (ONM) opened the Bougrine lead-zinc mine in May. The underground operation will process 350 000 t/y of ore and produce 9000 t/y of lead in concentrate.

Zambia Consolidated Copper Mines Limited permanently closed the Kabwe lead-zinc mine because of rising operating costs. The underground operation had a rated capacity of 6000 t/y of lead and 20 000 t/y of zinc in concentrate.

Secondary Production/Recycling

Lead is one of the most recycled nonferrous metals in the world. Secondary production (from recycled materials) has risen steadily and surpassed primary output for the first time in 1989 (Figure 1). This growth reflects the favourable economic conditions associated with lead recycling and the fact that lead retains its physical and chemical properties when recycled. As lead is used worldwide, scrap lead has become a readily renewable resource to which countries without lead mines have access.

Figure 1
World Lead Metal Production,[1] 1970-94



Source: International Lead and Zinc Study Group.
[1] Excludes Eastern European and socialist countries.

Secondary lead output increased in North America with smelters operating at or close to capacity. Strong battery demand and good scrap availability from the replacement battery market were partly responsible for the increase in production.

GNB continued with construction of a 90 000-t/y secondary lead smelter in Columbus, Ohio. When it is commissioned in early 1995 the new facility will partially replace the existing 20 000-t/y plant.

RSR Corporation's proposed 110 000-t/y secondary lead smelter in Aiken County, South Carolina, was put on hold because of permitting difficulties. The US$65 million-$75 million facility was scheduled to start up in 1995.

In Europe, secondary production is expected to have declined in 1994 due in part to summer closures and an insufficient supply of feed in some countries. Although scrap prices increased in response to strengthening LME prices, the rise in value did not translate into an expected increase in scrap availability. Factors contributing to the muted response in availability were reported to be higher environmental costs for the storage and transportation of scrap, new European Union regulations on the movement of hazardous waste that were introduced on May 6, and merchants holding on to stocks in anticipation of further rises in scrap prices.

Metaleurop S.A. reduced output by almost 50% at its 41 000-t/y Oker secondary lead smelter as part of a restructuring of the company's German lead operations. It was also reported that the company's Nordenham primary smelter would process battery paste formerly treated at Oker.

According to October estimates from the ILZSG, Brazilian lead metal production is forecast to decline by 23% in 1994 from 78 000 t in 1993. The decline is partly a result of the suspension of operations at Faé S/A Industria e Comercio de Metais's 24 000-t/y secondary lead plant at Sao Bernardo do Campo. Operations were reportedly suspended in March because of environmental concerns and only re-opened for a three-week trial period at the end of June. In 1993, secondary lead production accounted for about 60% of Brazil's total lead metal output and for 61% of South American secondary output.

In Japan, Mitsui Mining and Smelting Co. Ltd. and Mitsubishi Materials Corporation announced that they will stop using concentrates and source only scrap lead material as feed for the 34 000-t/y Kamioka and 22 000-t/y Hosokura smelters, respectively.

In Malaysia, Metal Reclamation Industries plans to expand production by 16 000 t/y to 40 000 t/y at its Selayang secondary lead smelter during 1995.

CONSUMPTION AND USES

On the basis of preliminary statistics from the ILZSG, Western World lead consumption increased

by 5% from the 1993 total of 4 495 000 t, the strongest annual growth in 17 years.

In Japan, demand declined for the third consecutive year, a drop of 7% from 1993. By contrast, the United States and Asia, excluding Japan, boasted the strongest growth of 9% and 23%, respectively. Europe and the United States each accounted for 32% of Western World lead demand while Japan consumed 7%. During the last two decades, demand for lead in Asia, excluding Japan, has increased by a factor of 6 and, in 1993, accounted for 15% of Western World demand. The increase largely reflects the rapid pace of economic growth in this region.

Lead is a dense, bluish-white metal whose physical and chemical properties find application in a variety of uses in the manufacturing, construction and chemical industries.

Lead-acid batteries constitute the largest market for lead, representing about 65% of total usage in the Western World. In the United States, battery manufacturing constitutes about 80% of total lead demand. The largest market for batteries, representing about 80% of lead used in the industry, is the automotive sector. The average automobile battery contains about 10 kg of lead. Some factors which influence lead demand in the automotive sector are new vehicle production, trends and age in vehicle population, and climatic conditions. In 1994, extremely cold winter temperatures and a hot summer reduced battery life and contributed to a surge in replacement battery demand in North America.

A potential growth area for the lead-acid battery is in energy storage facilities for utilities. These are designed to supplement existing generators during the peak morning and evening hours without drawing on other sources or building new power plants.

Electric cars may provide the greatest future growth in demand for lead-acid batteries. In 1990, California approved stringent automobile emission standards which will require, by 1998, 2% of new cars sold in the state to be zero emission or electric powered, with the figure increasing to 10% by the year 2003. It has been estimated that this would amount to 40 000 electric vehicles by 1998. It was reported that similar requirements may also be adopted by 10 eastern states which, when combined with California, account for one third of the total U.S. new car and light truck market. Furthermore, it was estimated that if every state followed California's lead, then 1.7 million electric vehicles might be required by 2003. The "Big Three" automobile producers (General Motors Corp., Ford Motor Corp. and Chrysler Corp.) are experimenting with different battery prototypes but are concerned that electric vehicles will not be commercially viable before the year 2000. As for environmental concerns, the U.S. Environmental Protection Agency is reportedly concerned that the increase in energy requirements for electric vehicles could result in greater pollution in areas where power plants are fuelled by coal and oil.

This new demand for lead will also increase the incentive to develop a longer-lasting, more efficient and cost-competitive substitute for the lead-acid battery. General Motors Corp.'s "Impact" electric car is currently powered by a lead-acid battery. However, the company has also entered into an agreement with Energy Conversion Devices Inc. to develop a nickel-metal hydride battery. Nissan is developing a future electric vehicle to be powered by a nickel-cadmium battery that is expected to achieve full charge in 15 minutes. Isuzu Motors Ltd. and Fuji Electrochemical Co., Ltd. expect to market a new revolutionary battery made of activated carbon and diluted sulphuric acid that recharges faster and produces more power than conventional batteries. Also competing are Kansai Electric Power Co., Inc. and Japan Storage Battery Co., Ltd., who are developing a new nickel-zinc battery. Other candidates include a zinc-based slurry developed by Luz International that generates energy when combined with oxygen, and which can be recharged in minutes by adding fresh slurry. There is also the Australian-designed vanadium redox battery that is reported to be recyclable, more efficient, longer lasting and which requires one eighth the time to recharge than a lead-acid cell. The Canada Centre for Mineral and Energy Technology (CANMET) of Natural Resources Canada is participating with industry in the development of a lithium-aluminum-iron sulphide battery and a sodium-sulphur battery.

Some experts believe that the lead-acid battery is the only technology that can be counted on to meet new electric vehicle demand in the short-to-medium term. Compared with other battery systems, these batteries are easily recycled, relatively inexpensive and considered to be free from safety concerns.

In March 1992, an Advanced Lead-Acid Battery Consortium was formed to develop an improved lead-acid battery for the electric vehicle. The consortium currently has 37 members representing lead producers, battery companies, and an automotive manufacturer. The membership is from 11 countries and Canadian sponsors are Cominco and Noranda.

The "Horizon" lead-acid battery produced by Electrosource Inc. and BDM Technology Inc. is reported to be one of the most promising new technological developments. The battery has plates made of lead wire co-extruded in a woven pattern on a fibreglass core. Therefore, it is lighter than traditional batteries with lead cast plates and reportedly lasts three times longer, can be recharged in minutes, and offers more power.

Hyundai Electronics Industries has developed a new, sealed, rechargeable lead-acid battery for use in personal computers and cellular phones. The new battery has the same capacity as nickel-cadmium batteries but is cheaper.

The second largest use of lead is in pigments and compounds, accounting for 13% of Western World demand in 1992. The principal uses are in PVC stabilizers, which prevent degradation during processing

or from ultraviolet radiation; colour pigments; and the manufacture of glass, including crystal, light bulbs, insulators and television/computer screens. While lead is still used for some specific paint applications, its general use in this application has declined significantly due to the potential risk involved in exposure to weathered or flaked paint.

Until the mid-1970s, the production of lead additives for gasoline, including tetraethyl lead, constituted one of the most important markets for the metal. However, with the adoption of environmental regulations that have either prohibited or severely restricted the use of such additives, the demand for lead in this application has declined dramatically. In Canada, lead was eliminated, through legislation, as an additive in gasoline for general consumption at the end of 1990.

Lead is alloyed with tin in the production of solder used in both the electronics and plumbing sectors. In the plumbing industry, the demand for lead has fallen primarily as a result of the increasing use of plastic piping. Where metal systems are still used for potable water systems, new regulations, which have been adopted or are being considered, will reduce the amount of lead in solder. In the electronics field, the move to miniaturization, combined with the replacement of printed circuit boards, has also reduced the demand for lead in solder.

Lead is also used with tin in foil for wine bottle capsules. However, this practice is being phased out in many countries because of environmental and health concerns. In mid-1991, the European Community announced it would ban the use of tin-lead capsules as of January 1, 1993. Aluminum, plastics (PVC) and tin-based products have been used to replace lead foil.

Other important applications of both lead metal and lead alloys include: the production of free machining steel and brass, rolled sheet and strip for roofing applications, power and communication cable sheathing, especially for underground or submarine environments, and as a sound barrier material in construction.

Lead's high resistance to gamma radiation and X rays makes it the preferred metal for shielding around X-ray equipment and at nuclear installations.

Potential new uses for lead include: nuclear waste disposal applications; liquid metal (magnetohydrodynamics), a method of generating electricity by passing an electrically conducting fluid through a magnetic field; additives to extend the life of asphalt; barriers or shields against radon gas and electromagnetic fields; and as a damper to protect buildings from vibrations during earthquakes.

New uses for lead-acid batteries are also being developed. In Canada, Black & Decker Canada Inc. introduced a new cordless, electric lawn-mower during 1992. The fluidless lead battery can operate for about one hour before running out of power, regains 80% of its power after 3-4 hours of recharging, and can be fully recharged overnight. The new mower was marketed in the United States in 1993.

The latest high-tech use for lead was developed in 1992. U.S. and Russian scientists successfully focused cold neutrons into a beam that can penetrate substances and show where contaminants lie in a silicon semi-conductor, or discern how quickly atoms diffuse through aerospace alloys. The focused beam was created with a lens constructed of lead-silica glass. It was also reported that companies using advanced materials will benefit the most from cold-neutron focusing.

MARKETS, PRICES AND STOCKS

Overall, the lead market was relatively balanced in 1994 as it moved from a supply surplus in the first half to a supply deficit in the second half because of strong demand and a shortage of raw materials.

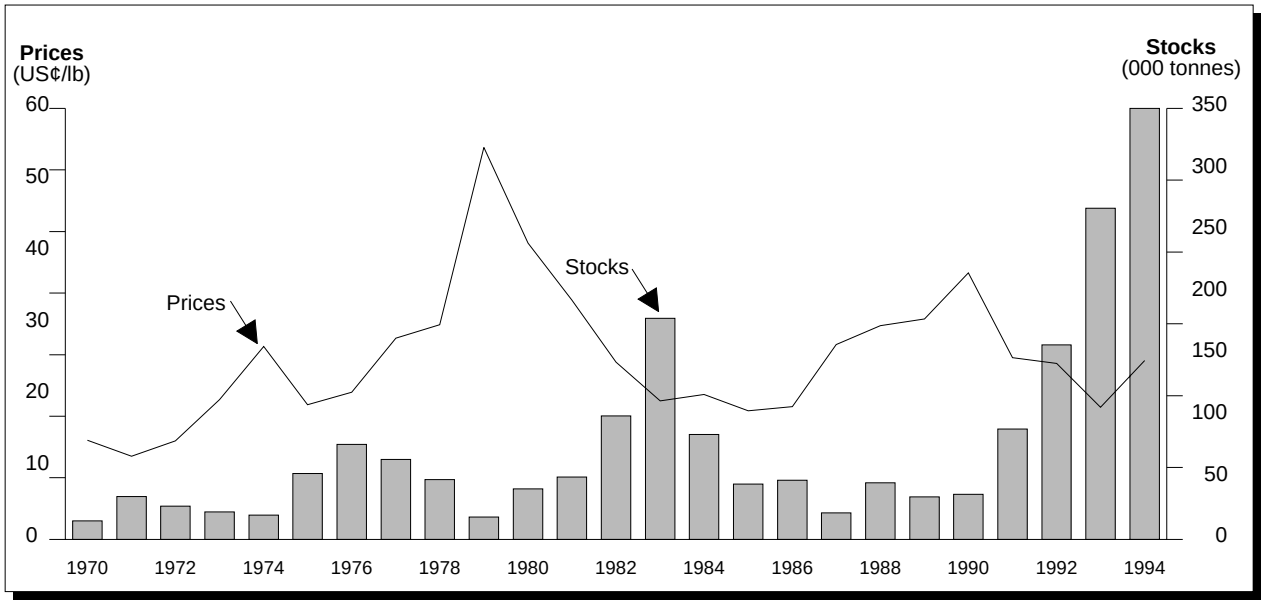
The fall in lead prices seen during 1993 continued through the first quarter of 1994 to a low of US19.3¢/lb in April. As demand strengthened and producer inventories fell because of primary smelter production cuts due to concentrate shortages, the price of lead slowly recovered and was further supported by a supply deficit and a drawdown of LME stocks beginning in the third quarter. The price of lead peaked at 31¢/lb in mid-November, but fell to 29.5¢/lb by year-end due in part to speculation from fund investors. The average price of lead on the LME for 1994 was 18¢/lb.

At the end of 1993, total lead stocks stood at 650 000 t, including 304 000 t on the LME. With continued exports from the former Soviet Union and China, LME stocks rose to 370 000 t in October before being drawn down to 343 000 t at the end of the year. However, producer stocks began to decline in the second quarter and fell to a year low of 130 000 t in November, the lowest level to be recorded in the 35-year history of the ILZSG. Total lead stocks stood at 636 000 t at the end of 1994.

INTERNATIONAL ORGANIZATIONS

The International Lead and Zinc Study Group was formed in 1959 to improve market information and to provide opportunities for regular intergovernmental consultations on lead and zinc markets. Particular attention is given to providing regular and frequent information on supply and demand and their probable development.

Figure 2
Lead Prices[1] and Stocks,[2] 1970-94



Source: International Lead and Zinc Study Group.
[1] Annual average London Metal Exchange (LME) prices.
[2] Annual average of LME month-end stocks.

The Study Group is headquartered in London, England. Its membership includes most major lead- and zinc-producing and consuming countries. While it has an extensive information-gathering and dissemination role, the Study Group has no market intervention powers. Member countries' delegations generally include a number of industry representatives as advisors. Canada has been an active member since its inception.

HEALTH, SAFETY AND THE ENVIRONMENT

The OECD published the *Risk Reduction Monograph No. 1: Lead* in 1993, which documents lead's commercial life cycle, exposure, releases and control mechanisms in place in various OECD countries. The report revealed lead's high recycling rate (over 50% of refined lead production is derived from scrap). The document also shows how lead is being used more than ever before, while the levels of lead in air, food and blood in the general population have declined to below national levels of concern in all countries that monitor lead in the environment. Declines in exposure are in part a result of the phase-out of dissipative uses of lead while the overall increase in lead consumption reflects strong demand for batteries and other non-dissipative uses.

In September 1994, Canada hosted an OECD Workshop on Lead Products as part of a process to determine if there are concerns that require international solutions. Approximately 200 experts from 14 countries participated in the workshop in Toronto and agreed that most concerns were not transboundary or international in nature and, for those that were, they could be resolved through national, regional or bilateral initiatives or through existing international institutions (e.g., International Standards Organization).

To address concerns identified by the workshop and the Lead Monograph, Canada has proposed a cost-effective and solution-oriented Action Program based on having a voluntary agreement with industry that advocates product stewardship and sustainable development. By contrast, the United States and the European Commission are proposing that the OECD develop a Council Act on lead.

The European Union ratified the Basel Convention during 1994. This United Nations (UN) convention restricts the transboundary movement of "hazardous waste" when destined for either final disposal or recycling operations. The Basel definition of wastes includes all recyclable materials. The Basel Convention has adopted a recent "ban" decision which would immediately prohibit movements of hazardous wastes from OECD countries to non-OECD countries when destined for final disposal. This "ban" decision will also prohibit the movement of hazardous wastes from OECD countries to non-OECD countries when destined for recovery operations effective December 31, 1997. Recyclable lead materials (spent

batteries, etc.) are currently classified internationally as wastes and, if lead is considered hazardous by national definitions, could be subject to strict transboundary movement controls or bans.

Lead was also raised in a number of other international fora during 1994 such as the UN Commission on Sustainable Development and the Summit of Americas.

OUTLOOK

The supply deficit that began in the third quarter of 1994 is predicted to prevail throughout most of 1995. Western World lead consumption grew by about 5% in 1994, with a further increase of more than 2.5% expected in 1995. Demand is forecast to remain strong in North America and to strengthen in Europe as economies continue to recover from the recession. However, metal supply will probably be unable to meet demand because the concentrate market is expected to remain tight until mines re-open or come on stream later this year and in 1996. The shortage of concentrates could also limit opportunities for toll smelting in the former Soviet Union, thereby reducing lead metal exports to the Western World, and could increase prices for scrap material as more primary facilities source greater quantities of secondary feed. Producer inventories are at historical lows and LME stocks are predicted to continue to be drawn down.

The average price of lead was US24.9¢/lb in 1994. As inventories fall, the price is forecast to increase and range between 27¢ and 36¢/lb in 1995 with the potential to rise quickly, similar to the 60¢/lb spike in 1992, if there are substantial disruptions in supply.

In the long term, lead demand is anticipated to maintain an average growth rate of 1.0-1.5%/y into the early part of the next century. The battery sector will account for most of the growth, with the newly industrialized nations of Southeast Asia expected to record the most rapid growth. The newly developing electrical vehicle market may further increase demand for lead, especially if governments adopt legislation, similar to California's, that requires a portion of new vehicles sold to be exhaust-free. Offsetting these bullish influences is the potential for legislative controls on the use of lead including, perhaps, non-dissipative uses that pose little direct danger of exposure.

Greater secondary output and primary production (from new and re-opened mines) will likely surpass demand and place minor downward pressure on prices in the medium-to-long term. The price of lead is forecast to range between 24¢ and 30¢/lb early in the next century.

Canadian mine output is expected to grow in 1995 to 190 000 t as some mines re-open. In the long term, production will continue to rise as new mines come on stream. However, output may fall early in the next century if depleted reserves are not replaced.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 60. (2) Information in this review was current as of January 15, 1995.

TARIFFS

Item No.	Description	Canada			United States	EU	Japan[1]
		MFN	GPT	USA	Canada[1]	MFN	MFN
2607.00	Lead ores and concentrates	Free	Free	Free	.5¢/kg on Pb	Free	Free
78.01	Unwrought lead						
7801.10	Refined lead						
7801.10.10	Pig and block	Free	Free	Free	0.9% on Pb	3.5%	8 yen/kg
7801.10.90	Other	8.8%	Free	3.0%	0.9% on Pb	3.5%	8 yen/kg
7801.91	Containing by weight antimony as the principal other element						
7801.91.10	Lead-antimony-tin alloys	6.0%	Free	2.0%	0.9% on Pb	3.5%	6.5%
7801.91.90	Other	8.8%	Free	3.0%	0.9% on Pb	3.5%	6.5%
7801.99	Other						
7801.99.10	For refining, containing 0.02% or more by weight of silver (bullion lead)	8.8%	Free	3.0%	0.9% on Pb	Free	4.7%
7801.99.20	Lead alloys	8.8%	Free	3.0%	1.0% on Pb	3.5%	4.7%
7801.99.90	Other	8.8%	Free	3.0%	1.0% on Pb	3.5%	8 yen/kg
7802.00	Lead waste and scrap	Free	Free	Free	Free	Free	3.2%
7803.00	Lead bars, rods, profiles and wire						
7803.00.10	Bars and rods, not alloyed	3.7%	2.5%	1.2%	0.3%	8%	5.8%
7803.00.20	Bars and rods, of lead-antimony-tin alloys	6.0%	Free	2.0%	0.3%	8%	5.8%
7803.00.30	Bars and rods, of other alloys; profiles and wire	8.8%	Free	3.0%	0.3%	8%	5.8%
7804.20	Powders and flakes						
7804.20.10	Powders, not alloyed	3.7%	Free	1.2%	3.3%	2.2%	6.5%
7804.20.20	Alloyed powders; flakes	8.8%	Free	3.0%	3.3%	2.2%	6.5%

Sources: Customs Tariff, effective January 1995, Revenue Canada; Harmonized Tariff Schedule of the United States,1995; The "Bulletin International Des Douanes," Journal Number 14 (16th Edition), European Economic Community, 1992-93, "Conventional" column; 1st Supplement to Journal No. 14 (16th Edition), European Economic Community, 1993-1994, "Conventional" column; Customs Tariff Schedules of Japan, 1994.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, LEAD PRODUCTION AND TRADE, 1993 AND 1994, AND CONSUMPTION, 1992 AND 1993

Item No.		1993		1994p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS[1]					
	Newfoundland	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	72 108	37 785	72 422	53 809
	Quebec	–	–	–	–
	Ontario	–	–	–	–
	Manitoba	1 933	1 013	422	314
	Saskatchewan	–	–	–	–
	Alberta	–	–	–	–
	British Columbia	52 030	27 263	57 518	42 736
	Yukon	27 857	14 597	–	–
	Northwest Territories	29 178	15 289	36 058	26 791
	Total	183 105	95 947	166 420	123 650
	Mine output[2]	183 155	..	171 626	..
	Refined production				
	Primary	147 907	..	145 500	..
	Secondary	69 107	..	97 800	..
	Total	217 014	..	243 300	..
EXPORTS					
2607.00	Lead ores and concentrates				
	Germany	22 133	10 116	29 275	17 071
	United States	1 124	2 480	3 288	14 391
	Norway	1 293	626	1 600	989
	Belgium	1 354	655	1 394	920
	France	5 872	2 841	946	624
	Other countries	56 014	7 661	1 793	1 185
	Total	87 791	24 379	38 295	35 180
2607.00.20	Lead content of lead ores and concentrates	61 312	18 347	35 131	20 841
2603.00.20	Lead content of copper ores and concentrates	2 879	520	967	208
2608.00.20	Lead content of zinc ores and concentrates	32 237	15 805	17 383	5 230
2616.10.20	Lead content of silver ores and concentrates	–	–	163	54
7801.10	Refined lead, unwrought				
	United States	101 044	55 652	119 079	91 973
	Thailand	2 524	1 324	3 007	1 899
	South Korea	1 813	886	1 913	1 035
	Philippines	1 434	762	1 884	972
	Malaysia	652	361	1 139	834
	Indonesia	735	382	1 508	826
	Other countries	15 747	8 439	3 739	2 100
	Total	123 950	67 806	132 270	99 638
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	9 687	6 489	9 920	8 332
7801.99	Lead, unwrought, n.e.s.	27 889	20 142	35 458	31 290
7802.00	Lead waste and scrap				
	United States	3 178	1 073	6 343	2 835
	India	–	–	19	5
	Vietnam	22	2	–	–
	Germany	154	20	–	–
	Total	3 354	1 096	6 361	2 840
7803.00	Lead bars, rods, profiles and wire				
	United States	328	683	508	1 059
	Singapore	5	8	5	3
	Cuba	2	2	1	2
	United Kingdom	1	2	–	–
	Malaysia	1	1	–	–
	Total	337	698	514	1 065

TABLE 1 (cont'd)

Item No.		1993		1994p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	201	288	211	301
7804.19	Lead plates, sheet, strip and foil, n.e.s.	117	76	37	50
7804.20	Lead powders and flakes	5	35	169	541
7805.00	Lead tubes, pipes and tube or pipe fittings (i.e., couplings, elbows, sleeves)	43	170	11	26
7806.00	Other articles of lead, n.e.s.				
	United States	..	2 830	..	3 679
	Romania	..	8	..	13
	Brazil	–	–	..	10
	United Kingdom	..	71	..	7
	Sweden	..	13	..	7
	Other countries	..	153	..	19
	Total	..	3 075	..	3 735
IMPORTS[3]					
2607.00	Lead ores and concentrates				
	Peru	24 285	4 099	14 117	8 835
	South Africa	–	–	23 886	7 081
	United States	16 349	7 593	9 090	5 025
	Chile	–	–	86	51
	Australia	11 545	1 674	–	–
	Total	52 179	13 366	47 180	20 994
2607.00.00.20	Lead content of lead ores and concentrates	13 730	7 552	25 776	15 754
2603.00.00.20	Lead content of copper ores and concentrates	–	–	303	225
2608.00.00.20	Lead content of zinc ores and concentrates	7 575	5 288	9 816	10 282
2616.10.00.20	Lead content of silver ores and concentrates	4 533	2 127	4 857	2 710
7801.10.10	Refined lead, unwrought, pig and block	7 664	4 653	4 315	3 217
7801.10.90	Refined lead, unwrought, other	3 085	1 722	152	313
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	21	31	492	415
7801.99	Lead, unwrought, n.e.s.	463	502	1 418	1 218
7802.00	Lead waste and scrap				
	United States	38 694	8 343	67 914	15 191
	United Kingdom	19	12	–	–
	Hong Kong	–	–	17	9
	Other countries	3	2	–	–
	Total	38 716	8 358	67 931	15 201
7803.00	Lead bars, rods, profiles and wire				
	United States	176	205	161	239
	Taiwan	–	–	31	49
	Belgium	26	41	3	5
	People's Republic of China	–	–	1	1
	Other countries	12	15	1	2
	Total	215	261	197	296
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	202	384	236	411
7804.19	Lead plates, sheet, strip and foil, n.e.s.	298	415	140	208
7804.20	Lead powders and flakes	148	185	79	114
7805.00	Lead tubes, pipe and tube or pipe fittings (i.e., couplings, elbows, sleeves)	15	39	19	37

TABLE 1 (cont'd)

Item No.		1993		1994p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7806.00	Other articles of lead				
	United States	. .	3 202	. .	3 814
	Germany	. .	44	. .	50
	Japan	. .	25	. .	39
	United Kingdom	. .	9	. .	29
	Taiwan	. .	10	. .	11
	Other countries	. .	23	. .	11
	Total	. .	3 313	. .	3 954

	1992[6]			1993		
	Primary	Secondary[5]	Total	Primary	Secondary[5]	Total
	(tonnes)					
CONSUMPTION[4]						
Lead used for, or in the production of:						
Antimonial lead	x	x	30 730	x	x	27 623
Batteries and battery oxides	23 599	12 993	36 593	22 171	12 933	35 104
Chemical uses; white lead, red lead, litharge, tetraethyl lead, etc.	x	x	13 175	x	x	12 208
Copper alloys; brass, bronze, etc.	146	2	148	116	10	126
Lead alloys:						
solders	1 012	170	1 182	1 324	961	2 285
others (including babbitt, type metals, etc.)	1 369	3 143	4 512	2 394	1 834	4 228
Semi-finished products: pipe, sheet, traps, bends, blocks for caulking, ammunition, etc.	797	790	1 587	1 761	849	2 609
Other lead products	2 099	1 694	3 793	2 836	2 121	4 958
Total, all categories	43 534	48 185	91 719	45 389	43 752	89 141

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary; x Confidential.
1 Production includes recoverable lead in ores and concentrates shipped, valued at the average Montréal price for the year. 2 Lead content of domestic ores and concentrates exported. 3 Imports from "other countries" may include re-imports from Canada. 4 Available data, as reported by consumers. 5 Includes all remelt scrap lead used to make antimonial lead. 6 Increase in number of companies being surveyed.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, LEAD PRODUCTION, TRADE[1] AND CONSUMPTION, 1975, 1980, AND 1985-94

	Production				Exports[1]			Imports	Consumption[3]
		Refined							
	All Forms[2]	Primary	Secondary	Total	In Ores and Concentrates	Refined	Total	Refined	
	(tonnes)								
1975	349 133	171 516	. .	171 516	211 909	110 882	322 791	1 962[a]	89 192
1980	251 627	162 463	72 117	234 580	147 008	126 539	273 547	2 602[a]	106 836
1985	268 291	173 220	66 791	240 011	93 657	113 993	207 650	5 675[a]	104 447
1986	334 342	169 934	87 746	257 680	118 373	111 831	230 204	4 247[a]	94 680
1987	373 215	139 475	91 186	230 661	207 936	100 204	308 140	12 558[a]	97 281
1988	351 148	179 461	88 615	268 076	200 822	179 946	380 768	15 132	88 041
1989	268 887	157 330	85 515	242 845	170 568	121 444	292 012	11 708	87 715
1990	233 372	87 180	96 465	183 645	221 565	84 007	305 572	11 756	71 467[r]
1991	248 102	106 420	105 946	212 366	175 150	86 631	261 781	7 553[r]	79 555
1992	339 626[r]	151 252	101 633[r]	252 885[r]	190 822[r]	131 546[r]	322 368[r]	8 289	91 719
1993	183 105	147 907	69 107	217 014	96 428	124 610	221 038	11 612	89 141
1994p	166 420	145 500	97 800	243 300	53 644	133 201	186 846	5 119	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; p Preliminary; r Revised.
a Lead in pigs, blocks and shot.
1 Beginning in 1988, Exports and Imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2603.00.20, 2607.00.20, 2608.00.20 and 2616.10.20. Refined exports include HS classes 7801.10, 7803.00, 7804.11, 7804.19 and 7804.20. Refined imports include HS classes 7801.10.10.00, 7801.10.90.00, 7803.00, 7804.11, 7804.19 and 7804.20. 2 Recoverable lead in ores and concentrates shipped. 3 Consumption of lead, primary and secondary in origin, as measured by a survey of consumers.

TABLE 3. CANADA, LEAD SMELTING CAPACITY, 1993

Company and Location	Annual Rated Capacity
	(000 t of refined lead)
Cominco Ltd.[2] Trail, British Columbia	135
Metalex Products Ltd.[1] Burnaby, British Columbia	6
Canada Metal Company[1] Winnipeg, Manitoba	10
Canada Metal Company[1] Toronto, Ontario	12
Tonolli Canada Ltd.[1] Mississauga, Ontario	50
Nova Lead Inc.[1] Ville Ste-Catherine, Quebec	60
Brunswick Mining and Smelting Corporation Limited[2] Belledune, New Brunswick	72
Total Canada	345

Source: Natural Resources Canada.
[1] Process lead-bearing scrap. [2] Process lead-bearing concentrate and scrap.

TABLE 4. AVERAGE ANNUAL LEAD PRICES, 1975-94

Year	London Metal Exchange			
	Settlement		Three Months	
	(£/t)	(US¢/lb)	(£/t)	(US¢/lb)
1975	185.63	18.755	186.78	18.821
1976	250.70	20.480	259.79	21.275
1977	354.11	28.022	359.12	28.433
1978	342.79	29.886	342.94	29.895
1979	567.66	54.574	542.66	52.161
1980	391.29	41.237	392.08	41.343
1981	363.37	33.327	370.93	34.025
1982	310.72	24.679	321.55	25.516
1083	279.97	19.290	290.62	19.983
1984	332.49	20.156	333.20	20.196
1985	304.01	17.876	304.03	17.877
1986	277.36	18.456	277.61	18.473
1987	363.66	27.098	346.40	25.736
1988	368.40	29.748	358.35	28.834
1989	412.39	30.669	406.41	29.908
1990	458.21	37.097	443.06	35.871
1991	315.23	25.303	325.84	25.805
1992	306.12	24.496	317.26	25.109
1993	274.40	18.128	274.87	18.728
1994	357.28	24.830	367.12	25.510

Sources: London Metal Exchange; *Metals Week*.

TABLE 5. AVERAGE MONTHLY LEAD PRICES, 1993 AND 1994

	London Metal Exchange			
	Settlement		Three Months	
	(£/t)	(US¢/lb)	(£/t)	(US¢/lb)
1993				
January	284.84	19.80	294.86	20.48
February	287.60	18.78	297.31	19.41
March	277.67	18.41	287.15	19.04
April	272.31	19.08	281.53	19.74
May	263.07	18.47	272.39	19.14
June	261.19	17.87	271.02	18.56
July	259.54	17.61	268.23	18.22
August	260.37	17.62	268.98	18.19
September	246.46	17.04	255.11	17.65
October	255.70	17.43	264.63	18.03
November	270.30	18.16	279.54	18.77
December	309.60	20.92	317.92	21.51
1994				
January	328.17	22.21	336.37	22.79
February	327.93	22.00	336.81	22.60
March	302.38	20.46	311.77	21.10
April	296.53	19.94	305.96	20.58
May	314.46	21.46	326.17	22.24
June	343.86	23.79	355.30	24.57
July	374.82	26.30	384.21	26.96
August	369.84	25.87	381.37	26.67
September	391.53	27.81	400.21	28.41
October	399.29	29.10	407.19	29.69
November	419.57	30.25	429.85	31.00
December	406.66	28.75	418.01	29.56

Source: *Metals Week*.

TABLE 6. NON-SOCIALIST WORLD LEAD CONSUMPTION, 1990-93

	1990		1991		1992		1993	
	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)
Batteries	2 543.3	63.2	2 569.1	64.0	2 567.6	64.5	2 679.2	66.2
Cable sheathing	182.1	4.5	164.0	4.1	148.5	3.7	139.8	3.5
Rolled and extruded products	310.6	7.7	285.0	7.1	273.0	6.8	267.2	6.6
Shot/ammunition	100.5	2.5	108.1	2.7	112.2	2.8	114.4	2.8
Alloys	132.7	3.3	122.5	3.0	138.0	3.5	139.7	3.5
Pigments and other compounds	517.0	12.8	535.9	13.4	545.1	13.7	506.4	12.8
Gasoline additives	86.9	2.2	74.0	1.8	58.1	1.5	54.3	1.3
Miscellaneous	153.2	3.8	158.1	3.9	140.1	3.5	146.3	3.6
Total	4 026.3	100.0	4 016.7	100.0	3 982.6	100.0	4 047.3	100.0

Source: International Lead and Zinc Study Group.
Note: Statistics are for Australia, Austria, Belgium, Brazil, Canada, Finland, France, Germany, India, Italy, Japan, the Republic of Korea, Mexico, the Netherlands, New Zealand, Scandinavia, South Africa, Southeast Asia, Spain and Switzerland, Thailand, the United Kingdom and the United States.

TABLE 7. REFINED LEAD CONSUMPTION BY COUNTRY, 1990-94

	1990	1991	1992	1993	1994p
			(000 t)		
AMERICAS					
Canada	83	78	89	74	73
United States	1 312	1 247	1 287	1 398	1 537
Mexico	119	133	164	157	157
Brazil	75	66	69	74	80
Other Americas	58	73	79	80	95
Total Americas	1 647	1 597	1 688	1 783	1 942
EUROPE					
United Kingdom	302	264	264	264	265
Germany	392	413	412	352	360
Italy	258	259	247	223	230
France	255	252	246	226	232
Spain	134	135	105	102	115
Other Europe	409	400	355	307	310
Total Europe	1 750	1 723	1 611	1 474	1 512
ASIA					
Japan	401	422	401	371	361
Korea, Republic of	149	164	164	201	218
Taiwan	70	83	109	101	115
India	75	75	60	70	75
Other Asia	201	234	274	318	413
Total Asia	911	978	1 008	1 061	1 182
OCEANIA					
Australia	53	56	59	62	66
New Zealand	6	6	4	5	5
Total Oceania	59	62	63	67	71
AFRICA					
South Africa	66	56	54	59	53
Egypt	13	16	11	12	12
Algeria	15	19	18	18	18
Other Africa	21	23	28	21	24
Total Africa	115	114	111	110	107
Total Western World	4 482	4 474	4 481	4 495	4 731
Other countries	930	743	657	664	585
Total world	5 412	5 217	5 138	5 159	5 305

Source: International Lead and Zinc Study Group.
p Preliminary (January-November).

TABLE 8. MINE PRODUCTION OF LEAD BY COUNTRY, 1990-94

	1990	1991	1992	1993	1994p
			(000 t)		
AMERICAS					
Canada	241	276	344	183	172
United States	497	477	407	363	368
Mexico	180	165	170	141	180
Peru	210	218	194	218	213
Other Americas	56	62	51	43	42
Total Americas	1 184	1 198	1 166	948	975
EUROPE					
Yugoslavia (former)	83	85	40	25	25
Sweden	85	87	106	104	113
Spain	62	50	31	25	32
Ireland	35	40	43	45	51
Greece	26	32	28	26	26
Other Europe	50	30	26	12	7
Total Europe	341	324	274	237	254
ASIA					
Japan	19	18	19	17	9
Iran	11	15	14	14	16
Turkey	18	12	10	11	10
India	26	25	31	30	27
Other Asia	37	34	30	14	10
Total Asia	111	104	104	86	72
OCEANIA					
Australia	556	579	575	521	520
AFRICA					
South Africa	69	76	77	100	95
Morocco	65	70	72	79	75
Namibia	25	21	20	18	18
Other Africa	16	14	8	9	4
Total Africa	175	181	177	206	192
Total Western World	2 367	2 386	2 296	1 998	2 013
Other countries	743	737	680	705	615
Total world	3 110	3 123	2 976	2 703	2 628

Source: International Lead and Zinc Study Group.
p Preliminary.

TABLE 9. REFINED LEAD PRODUCTION BY COUNTRY, 1990-94

	1990	1991	1992	1993	1994p
			(000 t)		
AMERICAS					
Canada	184	212	253	220	243
United States	1 291	1 195	1 182	1 206	1 273
Mexico	238	236	289	256	221
Peru	70	75	83	86	88
Brazil	76	64	63	78	80
Other Americas	41	46	50	48	47
Total Americas	1 900	1 828	1 920	1 894	1 952
EUROPE					
United Kingdom	329	311	347	364	365
Germany	349	362	354	334	343
Belgium	92	99	99	112	131
Italy	171	208	186	183	207
France	260	283	284	259	269
Sweden	76	88	91	82	79
Spain	130	112	55	61	72
Yugoslavia (former)	94	94	54	35	25
Other Europe	85	75	70	68	20
Total Europe	1 586	1 632	1 540	1 498	1 511
ASIA					
Japan	327	332	330	309	288
Republic of Korea	75	62	84	128	128
Taiwan	27	17	20	15	18
India	41	48	53	51	61
Other Asia	87	102	104	137	129
Total Asia	557	561	591	640	624
OCEANIA					
Australia	224	239	232	243	229
New Zealand	5	5	5	5	5
Total Oceania	229	244	237	248	234
AFRICA					
South Africa	31	32	29	32	30
Morocco	67	73	71	72	71
Namibia	35	33	32	31	26
Other Africa	18	17	18	22	23
Total Africa	151	155	150	157	150
Total Western World	4 423	4 420	4 438	4 437	4 471
Other countries	1 035	900	937	964	914
Total world	5 458	5 320	5 375	5 401	5 466

Source: International Lead and Zinc Study Group.
p Preliminary.