COPPER

By Daniel L. Edelstein

Domestic survey data and tables were prepared by Hema Edupuganti and Wanda Wooten, statistical assistants, and the world production tables were prepared by Regina R. Coleman and Glenn J. Wallace, international data coordinators.

In 2002, mine production of recoverable copper in the United States, which continued the downward trend that began in 1998, fell by more than 100,000 metric tons (t) to its lowest level since 1987. Production cutbacks previously imposed in the United States in response to sustained low copper prices continued into 2002. In January, Phelps Dodge Corp. implemented most of the additional cutbacks announced in October 2001—curtailing 165,000 metric tons per year (t/yr) of production by halting mining at its Miami, AZ, leach operations and halving production at its Sierrita, AZ, and Bagdad, AZ, mines. Its Chino, NM, electrowon operation, however, continued to operate, though no new material was added to the leach pads. It also temporarily closed its Chino smelter and Miami electrolytic refinery (Phelps Dodge Corp., 2001).

The strong growth trend in world mine production that began in 1995 came to an abrupt halt in 2002 when producers, primarily in Chile and the United States, instituted cutbacks. The United States, which accounted for about 8% of world production, relinquished its position as the world's second largest mine producer by falling to third place just behind Indonesia. Chile, where mine production declined by about 3%, remained the largest mine producer and accounted for 34% of world production. The reduced output took place despite a growth of more than 400,000 t in world mine capacity.

U.S. Geological Survey (USGS) estimates indicate world copper reserves of 480 million metric tons (Mt) and a copper reserve base of 950 Mt. The United States had about 7% each of the world's reserves and reserve base. According to the national mineral resource assessment conducted by the U.S. Geological Survey (2000, p. 10), the mean estimate of copper in undiscovered deposits in the United States was 290 Mt. More than two-thirds of the undiscovered copper was thought to be contained in porphyry copper deposits. The identified U.S. copper resource, from which reserves and reserve base are derived, was estimated to be 260 Mt.

U.S. smelter and refinery production fell by 26% and 16%, respectively, despite a 59,000-t increase in net imports of copper in concentrates. Phelps Dodge closed its Chino smelter and Miami electrolytic refinery in response to the reduced availability of concentrates from its mine cutbacks. Only three primary smelters and no secondary smelters operated during the year. Production at ASARCO Incorporated's Amarillo, TX, refinery was reduced significantly following cutbacks at its Mission Mine in Arizona and the closure of Chemetco Inc.'s secondary smelter near Hartford, IL, in 2001, which supplied anode to Amarillo. Electrowon production, which declined by about 28,000 t, accounted for a record 40% of refined copper production. Secondary refined production, which fell by 59%, was affected by the upstream closure of the Chemetco's smelter and reduced production at the three remaining fire refineries.

The United States fell to fifth place in world smelter and third place in refinery production.

The principal mining States were, in descending order of production, Arizona, Utah, and New Mexico, and accounted for 99% of domestic production; copper was also recovered at mines in Missouri and Idaho. Although copper was recovered at 22 mines that operated in the United States, just 12 mines accounted for more than 99% of production. The remaining 10 mines were either small leach operations or producers of byproduct copper.

During the year, 3 primary smelters, 4 electrolytic and 3 fire refineries, and 13 solvent-extraction electrowinning (SX-EW) facilities operated in the United States. Smelter capacity was revised downward to about 900,000 t to reflect the permanent closure of Chemetco, while refinery capacity remained unchanged at 2.3 Mt. Smelter and refinery capacity utilization rates fell to 76% and 66%, respectively, down from 91% and 78%, respectively, in 2001. While U.S. refinery capacity has declined by about 460,000 t since 1998, the closure of three primary smelters and three secondary smelters has led to a 1-Mt decline in smelter capacity. In the case of refineries, the net growth in electrowon capacity of about 90,000 t has partially offset refinery closures. Also, though operating at significantly reduced levels, engineered capacity has been retained at Asarco's and Phelps Dodge's electrolytic refineries, which are the two largest in the country.

The conversion of old scrap to alloys and refined copper, which declined for the fifth consecutive year, fell by 110,000 t (35%) to 207,000 t and contributed 8% of apparent industrial demand for copper. Lower copper prices in 2001 and secondary copper smelter closures led to the continued downward trend in recovery. Net exports of copper scrap of 411,000 t were down by about 7% from the record level of 2001.

Copper was consumed as refined copper and as direct melt scrap at about 30 brass mills, 13 wire-rod mills, and 500 chemical plants, foundries, and miscellaneous operations. According to data compiled by Copper Development Association Inc. (2003, p. 18), mill and foundry product shipments to the U.S. market, including net imports of mill products, declined by about 6% in 2002 to 3.24 Mt and were down by 21% from the record-high shipments reported in 2000. According to their revised data, mill shipments to domestic markets were at their lowest levels since 1993. Owing to erosion in U.S. refined production, the net import reliance for refined copper as a percentage of apparent consumption increased to about 37% and was at the same record-high level as in 2000.

Peru, Chile, Canada, and Mexico, in descending order, accounted for 89% of U.S. imports for consumption. Canada and Chile, which remained the country's largest sources for unwrought copper, accounted for 30% and 27%, respectively, of total imports of unwrought copper.

Legislation and Government Programs

On June 12, the U.S. Environmental Protection Agency (EPA) promulgated national emission standards for hazardous air pollutants (NESHAP) at primary copper smelters. The final rules apply to primary copper smelters that use batch copper converters. They are based on the assumption that copper smelters have the potential to release significant quantities of metals listed as hazardous air pollutants under the Clean Air Act, which include antimony, arsenic, beryllium, cadmium, cobalt, lead, manganese, nickel, and selenium, and that exposure to these pollutants has been demonstrated to cause adverse health effects. The standards reflect the application of the maximum achievable control technology (MACT) as they apply to particulate emissions. The NESHAP for primary copper smelters was first proposed in April 1998 and has been modified to account for numerous public review comments and changes in the domestic industry that took place since 1998. Of the seven smelters originally subject to NESHAP, four have suspended operations, and one (Kennecott smelter in Utah) has adopted new flash-converting technology that has eliminated the major source of fugitive emissions that were discharged during the transfer and handling of molten metal in the batch converting process. In response to industry comments, the new flash-converting technology at Kennecott was included in the broader definition of primary copper smelting but was excluded from this rulemaking and MACT standard. The rulemaking, in fact, set flash converting as the new standard for any new converting operation. While applicable to smelters with batch converting, the rule also sets emissions limits for concentrate dryers, smelting furnaces, slag cleaning vessels, and fugitive dust sources (U.S. Environmental Protection Agency, 2002b).

In April, the EPA published the results of its review of existing drinking water standards for 69 substances, which included copper, for which national primary drinking water regulations (NPDWRs) were established prior to 1997 and requested public comment on their proposed rules. The EPA published the current NPDWR for copper in June 1991, establishing a maximum contaminant level goal for copper of 1.3 milligrams per liter (mg/L). As part of its review, the EPA commissioned the National Research Council (NRC) in 1999 to examine available nutritional and toxicological data for copper and to provide recommendations. The NRC concluded that copper in drinking water in concentrations of 3 mg/L or higher could produce adverse gastrointestinal effects and could be a problem for individuals who carry a recessive gene for Wilson's disease (a condition which causes excess copper to accumulate in the liver). The NRC recommended retention of the 1.3-mg/L limit pending collection of additional data on the risk to carriers of the Wilson's disease gene and other populations with a propensity to accumulate copper in their livers. Accordingly, The EPA initiated a further assessment of copper's health risk and retained the current 1.3-mg/L standard pending reevaluation of the health risks (U.S. Environmental Protection Agency, 2002c).

In February, the EPA announced that it had received a voluntary request from the producers of chromated copper

arsenate (CCA) to cancel the authorization for the use of CCA pesticides in the treatment of certain lumber products. Implementation of this action would effectively eliminate the use of CCA to treat lumber for residential applications by December 31, 2003. A 2-year transition period would provide consumers with increasingly more non-CCA treated wood alternatives as the industry undergoes conversion and retooling to take advantage of alternative wood preservatives that do not contain arsenic. In announcing receipt of the producers' request, the EPA did not recommend that existing structures or surrounding soils be removed or replaced. The CCA registry with the EPA would be retained, however, for treatment of wood used in commercial applications, such as marine applications, round poles for building construction, sawn timbers to support residential construction, and highway timbers. Official cancellation of CCA use in residential products, as proposed in the industry's initial voluntary request, was announced on March 17, 2003 (U.S. Environmental Protection Agency, 2002d, 2003).

On November 22, the EPA announced that it had finalized a rule to improve its New Source Review Program and was proposing a rule to provide a regulatory definition of "routine maintenance, repair and replacement." These actions were intended to offer industry, which included copper producers, greater flexibility to improve and modernize plants in ways that would reduce energy use and air pollution. The final rule improvements, which were the culmination of a 10-year review process, will provide facilities with greater flexibility to modernize, incentives to install best available pollution control, and more accurate procedures for evaluating the effect of projects on future emissions and will expedite permitting of investments in pollution prevention (U.S. Environmental Protection Agency, 2002a).

Production

In response to the continuing global oversupply and resulting sustained low copper prices, previously announced mine cutbacks extended into 2002, and a new round of cuts was initiated at the onset of the year. Consequently, mine production dropped precipitously in January and remained at the lower level throughout the year. Annual production fell by almost 200,000 t (15%) to the lowest level since 1985. Capacity utilization at domestic mines fell to about 73% as production fell, and effective capacity remained at about 1.57 Mt.

Smelter production, which continued its downward trend, plummeted by about 26% and was only 52% of the production in 1999. Since then, five smelters have closed permanently three primary smelters in 1999 and two secondary smelters in 2000 and 2001. The production drop in 2002 was attributable to the closure of Chemetco's secondary smelter in November 2001 and the temporary closure of Phelps Dodge's Chino smelter at the start of the year owing to a shortage of concentrate feed. The U.S. concentrate supply, production plus net imports, fell by about 120,000 t of contained copper.

Downstream, refined copper production fell by 290,000 t, or 16%, owing to a shortage of anode feed from domestic smelters, reduced production from scrap, and a drop in net imports of blister and anode for refining. Electrowon production accounted for a record 53% and 40% of mine and refinery output, respectively.

In 2002, Phelps Dodge reported copper production of 1.157 Mt, which included minority participants' share of 224,000 t, from its worldwide operations, compared with 1.28 Mt and 228,000 t, respectively, in 2001. U.S. production amounted to 642,000 t (525,000 t electrowon and 117,000 t in concentrate), which was down from 764,000 t (533,000 t electrowon and 231,000 t in concentrate) in 2001 (Phelps Dodge Corp., 2003, p. 11). The drop in domestic production was the result of a series of cutbacks announced in October 2001 to address the "current economic environment and the 500,000-t/yr imbalance in the copper market owing to reduced demand" (Phelps Dodge Corp., 2001, p. 1). Though the company fell short of its goal, the temporary curtailments were expected to reduce output by 220,000 t/yr and were viewed as quickly reversible "should copper prices improve or circumstances warrant" (Phelps Dodge Corp., 2001, p. 3).

Following completion of a \$220 million mine-for-leach project and closure of its concentrators at its Morenci Mine in Arizona, Phelps Dodge produced a record 374,000 t of electrowon copper cathode, which exceeded projected capacity by several thousand metric tons. The crushing facility at the permanently closed Metcalf concentrator processed 77,000 metric tons per day (t/d) of ore for the expanded leach operation. Though the Morenci concentrator was being retained on a careand-maintenance status and could "under certain favorable economic circumstances" be reactivated, the USGS has excluded it in its capacity estimations. In 2002, Morenci placed almost 220 Mt of leach ore with an average grade of 0.28% copper on its leach pile. At yearend, run-of-the-mine leach reserves totaled 2.3 billion metric tons with an average grade of 0.19% copper, and millable leach reserves totaled 533 Mt with an average grade of 0.57% copper (Phelps Dodge Corp., 2003, p. 4, 11).

At the Bagdad Mine in Arizona, production fell by 35% to 76,700 t as mill throughput was reduced to about 50% of capacity as part of Phelps Dodge's comprehensive reduction plan. Production, however, exceeded initial expectations by about 23,000 t owing to higher-than-anticipated ore grades (0.43% mill and 0.29% leach) from changes in the mine plan, improved recovery rates from mill improvements, and recoveries from leaching operations that rose by 50% to 14,200 t. Also, mill throughput was increased to more than the 50% target at times to generate sufficient smelter feed to meet byproduct sulfuric acid demand (Phelps Dodge Corp., 2003, p. 4, 11).

In February, Phelps Dodge announced that it would construct a \$40 million copper concentrate leaching demonstration plant at its Bagdad Mine to recover commercial-grade copper cathode from chalcopyrite concentrates. The plant was expected to begin operations during the first half of 2003 and, at capacity, process 136 t/d of concentrate (15% of Bagdad's total production) to produce about 16,000 t/yr of electrowon copper. The new pressure leach process to be demonstrated was jointly developed by Phelps Dodge and Placer Dome, Inc. (Phelps Dodge Corp., 2002a).

As part of the Phelps Dodge curtailment program, mill throughput at the Sierrita Mine in Arizona was cut by 44%. Copper in concentrate, which fell by 37% to 54,400 t, was higher than originally anticipated owing to a 10% increase in

mill-head grade to 0.32% copper. Production of electrowon copper fell to 14,700 t (38%) owing to curtailment of leach ore production (Phelps Dodge Corp., 2003, p. 4, 11).

At its Miami, AZ, operations, Phelps Dodge temporarily closed its electrolytic refinery and stopped mining in January but continued to operate its smelter and wire-rod mill. Electrowon production from continued leaching of residual stockpiles yielded 9,500 t of copper. Production from the Miami smelter, which was Phelps Dodge's only operating smelter in 2002, amounted to 221,000 t of anode (Phelps Dodge Corp., 2003, p. 5, 13).

In New Mexico, curtailments were extended at the Chino Mine. In March 2001, the concentrator was temporarily idled resulting in the loss of about 79,000 t/yr of production. In January 2002, leach ore production was suspended, which reduced electrowon production to 49,000 t from 54,000 t in 2001, and the smelter was placed on care-and-maintenance status. Despite an increase in ore processed and 20% higher ore grades (0.35%), production of electrowon copper at Phelps Dodge's Tyrone Mine fell by about 6,000 t to 63,400 t; this continued a 5-year decline in output (Phelps Dodge Corp., 2003, p. 5, 11).

As a result of mine cutbacks and concentrate shortages, the company produced only 290,000 t of electrorefined copper at its El Paso, TX, refinery, down from a total production of 456,000 t at El Paso and Miami in 2001 (Phelps Dodge Corp., 2003, p. 5).

At the end of November 2001, Asarco announced that effective January 1, 2002, it would curtail copper ore production by 23% at its Mission mining complex in Arizona owing to poor market conditions. This reflected the second curtailment at Mission in 4 months and represented a total cutback of 61% since November 2000 (ASARCO Incorporated, 2001). In December 2002, Asarco announced another cutback at Mission that would reduce production to about 15% of capacity, or about 22,000 t/yr. The cutback was to reduce downstream production at the Hayden smelter and the Amarillo refinery by 33% and 13%, respectively (ASARCO Incorporated, 2002c). In 2002, Mission milled almost 8 Mt of ore to produce 36,600 t of copper in concentrate, which had dropped by 63,000 t in 2001 from 115,000 t in 1999. The reduction at Mission was partially offset by an increase in concentrate production to 131,000 t in 2002 from 113,000 t in 2001 at its Ray Mine in Arizona. Production of Ray electrowon copper, however, fell to 41,900 t, which was down from 46,700 in 2001. In Montana, Montana Resources Continental Pit (49% owned by Asarco) remained on care-andmaintenance status (Grupo México, S.A. de C.V., 2003, p. 13). Asarco temporarily halted stripping operations at Ray in June but resumed again in September. Ray had been maintaining high-production levels by high grading its ore (Platts Metals Week, 2002a).

On July 11, Asarco informed the U.S. Department of Justice (DOJ) that it intended to transfer ownership of its 54% stake in Southern Peru Copper Corp. (SPCC) [owned through its subsidiary Southern Peru Holdings Corp. (SPHC)] to its parent company Americas Mining Corp. (AMC). AMC (a wholly owned subsidiary of Grupo México S.A. de C.V.) controlled Grupo Mexico's copper mining interests in North America and South America. According to Asarco, the intent of the sale was to help it meet its future obligations and remain economically viable. The proceeds would allow Asarco to pay off a \$450 million loan that came due in the autumn to a consortium of lenders. By retiring the loan, Asarco hoped to free up significant cash each month that had been used for debt interest payments (ASARCO Incorporated, 2002a). On July 15, however, the DOJ filed a court injunction to block the deal. In its injunction, the DOJ cited that because of extensive environmental liabilities, Asarco's transfer of its subsidiary SPHC to Grupo Mexico would cause fraud or injustice to the United States and other creditors of Asarco and that Grupo Mexico had formed SPHC after acquiring Asarco for the purpose of defrauding the unsecured creditors of Asarco, including the United States, by attempting to insulate its stock from claims of such creditors. In its submission, the DOJ further claimed that Asarco's total environmental cleanup or payment obligations for sites in numerous Western States could amount to more than \$700 million. Asarco disputed this, however, and claimed that it would be in a much better position following the sale to meet its financial and environmental obligations and that its liability was no more than \$200 million (American Metal Market, 2002b; Platts Metals Week, 2002f). On August 13, Asarco and SPCC filed a stipulation agreement with the DOJ that legally bound Asarco from selling any of its SPCC shares until a U.S. court ruled on the DOJ motion. Asarco and the DOJ agreed in September to extend the moratorium on the sale of SPHC and agreed to ask the court for an expedited hearing, briefing, and discovery schedule (American Metal Market, 2002a). At the end of August, Asarco announced that it had submitted to the DOJ a comprehensive proposal for environmental remediation at its closed plants and other sites where the company had historically operated that addressed DOJ concerns (ASARCO Incorporated, 2002b). In January 2003, Asarco and the DOJ filed a final agreement with the U.S. District Court in Phoenix, AZ, clearing the way for Asarco to transfer the company's interest in SPCC to AMC (ASARCO Incorporated, 2003).

At Kennecott Utah Copper Corp., operations continued uninterrupted through yearend although Kennecott and the 1,200 members of United Steelworkers of America at the company were unable to reach a contract settlement following expiration of a 6-year labor agreement on September 30; the two sides had begun negotiating in mid-July. The company had reportedly offered wage increases and maintenance of existing benefits in exchange for "efficiencies and flexibilities" in labor practices (Platts Metals Week, 2002d). Negotiations broke down in October, and suits and countersuits were filed with the National Labor Relations Board (NLRB) by United Steelworkers and Kennecott. The NLRB subsequently dismissed both sets of charges, and at yearend, the two parties continued to negotiate (Pisculli, 2002).

Production of copper in concentrates, however, plummeted by 53,000 t to 260,000 t owing to the processing of harder and lower grade ore from the south side of the Bingham Canyon pit. Mill-head grade fell to 0.69% in 2002 from 0.73% copper in 2001. Production of refined copper, however, rose by 59,000 t to 294,000 t as a result of improved smelter performance and the drawdown of concentrate inventories (Rio Tinto plc., 2003, p. 42).

BHP Billiton's copper operations in Arizona remained shuttered throughout 2002. Copper production from the company's residual Arizona leach operations at Miami, Pinto Valley, and San Manuel, AZ, totaled 13,200 t, down from 23,800 t in 2001 (BHP Billiton, 2003, p. 9). In January 2002, BHP Copper Inc. (a subsidiary of BHP Billiton) permanently closed its mining operations at San Manuel. Included in the closure were the remaining in situ copper leach operations, which resulted in the loss of about 9,000 t/yr of electrowon copper cathode. BHP Copper also stopped pumping water from the underground mine, which had been placed on care and maintenance in August 1999, ensuring permanent loss of mining capacity. BHP Copper continued its efforts to sell the idled smelting, refining, and wire-rod facilities associated with the mine (BHP Billiton Base Metals, 2001).

In September, BHP Billiton announced that it would close its Nicolet Minerals Company offices in Crandon, WI, and abandon its plans to develop the Crandon underground copper and zinc mine. The Crandon deposit contains an estimated 55 Mt of ore lying between about 60 and 670 meters below the surface. The company planned to continue to secure environmental permits in anticipation of selling the project. The Governor of Wisconsin announced that the State, which had considered purchasing the 5,000-acre property from Nicolet, would not do so owing to the high price. The land and mineral rights appraised at between \$51.2 million and \$94 million (Rebhahn, 2002§¹). Billiton Plc (now BHP Billiton) had purchased the rights to Crandon from Rio Algom Ltd. of Toronto, Ontario, Canada, in 2000.

Summo Minerals Corp., which at midyear changed its name to Constellation Copper Corp., placed its Lisbon Valley Project on care and maintenance at the beginning of the year. The company had yet to begin development of the permitted project and cited the need for sustained copper prices to exceed \$0.85 per pound to justify the investment. The company continued to evaluate alternative scenarios that would allow development of the project at lower copper prices. A feasibility study to evaluate its development as a copper powder producer was abandoned the previous year. Lisbon Valley is a fully permitted and engineered open pit, heap-leach, SX-EW project designed to produce 18,000 t/yr of cathode copper (Constellation Copper Corp., 2003, p. 19).

The Johnson Camp Copper Mine (owned by Nord Resources Corp.) located 65 miles east of Tucson, AZ, was retained on a care-and-maintenance status. Although significant reserves remained, mining operations ceased in 1997, and leaching of stockpiles stopped in 2001. Environmental remediation and upgrade of facilities at the site continued during the year. The existing facilities included a 4,000-gallon-per-minute solvent extraction plant, a tank farm, and a 24-t/d electrowinning tank house. According to Nord, which was operating under Chapter 11 reorganization, the mine could be returned to production quickly upon receipt of necessary project financing. At an anticipated rate of 8,570 t/yr of cathode copper, the mine was expected to generate a positive cash flow (Nord Resources Corp, 2003§).

Consumption

Reported consumption of refined copper by domestic manufacturers declined precipitously by about 10% (250,000

 $^{^1} References that include a section mark (§) are found in the Internet References Cited section.$

t) and was down by about 22% from the record-high demand of 2000. Consumption of copper-base scrap used directly (melted or processed to chemicals) by manufacturers declined by about 9% to 1.26 Mt and contained 988,000 t of recoverable copper. An additional 61,000 t of copper was recovered in the consumption of aluminum-, nickel-, and zinc-base scrap.

During 2002, three fire refineries processed scrap to recover unalloyed copper products in the United States. Scrap was also consumed in relatively small quantities at several of the primary smelters. Chemetco, which operated the last remaining U.S. secondary smelter, closed in October 2001 and remained shuttered throughout 2002. The closure of Chemetco and reduced production at one fire refinery that operated intermittently throughout the year accounted for the large drop in secondary copper consumption.

Direct melt scrap, principally alloy scrap, was consumed at about 30 brass mills, 20 alloy ingot makers, and 500 foundries, chemical plants, and miscellaneous consumers. Of the 1.05 Mt of copper recovered from scrap, brass mills recovered 70%; brass and bronze ingot makers, 11%; copper smelters and refiners, 7%; and foundries, chemical plants, and miscellaneous manufacturers, which included aluminum and steel alloy producers, 12%. Alloyed copper products accounted for about 93% of the total copper recovered from scrap.

According to data compiled by American Bureau of Metal Statistics, Inc. (2003a), wire-rod shipments by domestic producers to the U.S. market fell by 5% in 2002, which was down by 12% from the record-high shipments in 2000. The apparent consumption for wire rod (shipments plus net imports) fell by 3% to 1.95 Mt, which was down by 15% from shipments in 2000. Net imports rose by 16% in 2002 to 194,000 t and accounted for 10% of apparent wire-rod demand. According to American Bureau of Metal Statistics, Inc. (2003b) data, brass mill product shipments by domestic producers rose by 1.4% in 2002 to 745,000 t following an 18.6% decline in 2001. Tube accounted for 35% of shipments; copper and copper-alloy rods and bars, 34%; and plate sheet and strip, 31%.

According to preliminary data from Copper Development Association Inc. (2003, p. 18-20), the supply of copper and copper-alloy products to the U.S. market by fabricators (brass mills, wire mills, foundries, and powder producers), which included net imports, declined to 3.32 Mt in 2002, which was down by 6% from the revised total of 3.53 Mt in 2001, and by 21% from the record-high shipments of 4.22 Mt in 2000. About 73% of shipments in 2002 was as unalloyed copper products. Brass mill products accounted for about 49% of total shipments to the domestic market; wire mill products, 47%; and foundry and powder products, 4%. In building construction, which was the largest end use sector, shipments declined by 4% and accounted for about 46% of the market. Building construction included products used for building wire, plumbing and heating, air conditioning and commercial refrigeration, builders hardware, and architectural applications. Shipments for electric/electronic products (23% market share) and industrial machinery and equipment (10% market share) declined by 16% and 3%, respectively. Consumption for transportation equipment (10% market share) rose by 3%, and consumer and general products (11% market share) remained unchanged.

As evidence of the continued weak U.S. demand for copper COPPER—2002

products, several companies announced facility closures. Phelps Dodge closed two U.S. wire and cable plants and consolidated other functions, which eliminated a total of 345 jobs. The Laurinburg, NC, magnet wire plant closed at yearend, and its production was shifted to the company's El Paso, TX, and Fort Wayne, IN, plants. Phelps Dodge also closed its West Caldwell, NJ, High Performance Conductors plant. The plant produced low-temperature wires generally used in aerospace and electronics applications (Phelps Dodge Corp., 2002b). Phelps Dodge's North American magnet wire operations also faced increased competition. Superior TeleCom Inc. (through its Mexican affiliate Grupo Essex de Mexico) began production during the fourth quarter of 2000 at a new state-of-the art magnet wire operation in Torreón, Mexico. With the addition of Torreón, Superior TeleCom operated eight magnet wire manufacturing facilities in North America (Superior TeleCom Inc., 2001).

In December, Olin Corporation announced that it was considering the possible closure of its brass manufacturing facility in Indianapolis, IN, owing to the weak market demand for its products. The plant manufactured copper and copper alloy sheet and strip products and employed about 200 people (Olin Corporation, 2002). In January 2003, Olin announced that closure would be completed by the end of the first quarter of 2003 and that, owing to capacity additions at its East Alton, IL, facility, it had sufficient capacity to meet customer needs (Olin Corporation, 2003). The plant had been shuttered or operating at significantly reduced capacity for the first 5 months of 2002.

Cerro Metal Products Co. closed its Paramount, CA, brass mill in November. The plant produced brass, bar, rod, shapes, and wire and was a consumer of yellow brass scrap. The company reportedly will continue to supply Western State markets from its Bellefonte, PA, plant (Platts Metals Week, 2002b).

Prices and Stocks

Copper prices, which had trended downward during most of 2001, finished the year on an upward trend following an announcement in November by BHP Billiton Base Metals, which was the world's second largest producer of copper, that it would temporarily reduce copper production by 170,000 t/yr (BHP Billiton Base Metals, 2001). The cutback was in response to a growing overproduction of copper and the doubling of refined inventories held on the global commodity exchanges [COMEX (a division of the New York Mercantile Exchange), London Metals Exchange Ltd. (LME), and Shanghai Futures Exchange]. At yearend 2001, 76% of exchange inventories were located in LME and COMEX warehouses in the United States (International Copper Study Group, 2003a, p. 19).

After falling slightly from their yearend rally during January 2002, copper prices remained relatively stagnant during a 3-month period as world exchange inventories climbed to more than 1.5 Mt in April. After peaking in April, exchange inventories began a slide that continued to the end of the year. At the end of May, prices responded to lower stock levels and several industry announcements of production cutbacks. During the first week of June, COMEX spot prices jumped to \$0.78 per pound, which was up from \$0.73 per pound prior to the

announcements. BHP Billiton announced on May 28 that it would extend production constraints at its Escondida Mine in Chile and that it would temporarily close sulfide operations at its Tintaya Mine in Peru through the end of 2002 (BHP Billiton, 2002b).

On June 4, Grupo México announced that it was closing its Cananea Mine copper facilities owing to a labor union strike; the strike was ultimately settled before the mine could be fully closed (Platts Metals Week, 2002c). Though prices softened slightly by monthend, the June COMEX spot price averaged \$0.76 per pound, which was up from \$0.73 per pound in May.

Prices weakened again during the third quarter of the year because exchange inventories remained well above 1 Mt. Despite apparent continued weakness in the market, however, copper prices strengthened in November and December; the COMEX price averaged above \$0.72 per pound, which was the highest level since a midyear price rise in June. The price rise was sustained by several industry announcements that affected the supply of copper. On October 30, SPCC announced that workers at its Toquepala Mine in Peru had gone on strike, which was the first such action at SPCC in more than 10 years (Platts Metals Week, 2002e). Also, Asarco's announcements during October and December about the fate of its Mission Mine and concerns over its stalled attempt to raise capital through the sale of its SPCC subsidiary signaled additional production cuts. On December 4, BHP Billiton announced that it would continue its program of "demand-based" production, which had been initiated in November 2001 at the Escondida Mine in Chile and the Tintaya Mine in Peru, and that it intended to keep its Pinto Valley Mine in Arizona and its Robinson Mine in Nevada on standby (BHP Billiton, 2002a).

At yearend 2002, despite the continued slide in inventories (global exchange inventories fell to 1.29 Mt) COMEX and U.S. producer prices finished on a downturn by falling to \$0.70 per pound and \$0.74 per pound, respectively. According to data compiled by the International Copper Study Group (2003a, p. 7), at the prevailing rate of consumption, total global yearend inventories (consumer, producer, governments, merchants, and exchanges) of 2.2 Mt represented about 53 days of supply, which was up from 52 days in 2001 and 32 days in 2000. At yearend 2002, 74% of exchange inventories and 46% of reported global inventories were held in the United States compared with 76% and 45%, respectively, at yearend 2001.

Trade

Net refined copper imports of 900,000 t were down by about 7% from the record-high level in 2001. General imports of refined copper of 1.06 Mt were 135,000 t higher than imports for consumption as material entered U.S. warehouses under bond. U.S. import reliance as a percentage of apparent demand rose to 37%. Canada remained the most significant source of unwrought copper products and from 1998 through 2002 accounted for 29% of unmanufactured imports, followed by Peru and Chile, with 25% each, and Mexico with 13%. Refined copper accounted for 72% of unwrought copper imports during this period.

Net imports of copper in concentrate, which had fallen to zero in 2000 owing to cutbacks in smelter capacity, rose to about

22.6

49,000 t in 2002. This was in part owing to reduced concentrate output from domestic mines and increased smelter production by one domestic producer that had been selling surplus concentrates into the U.S. market. Though down slightly from 2001 levels, reduced secondary processing capacity led to a sustained high level of scrap exports; combined scrap exports (alloyed and unalloyed) of 511,000 t in 2002 were down by 23,000 t compared with that of 2001.

According to U.S. Census Bureau data compiled by Copper and Brass Fabricators Council Inc. (2003, p. 1-9), the United States imported 270,000 t of copper and copper-alloy semifabricated products (excluding wire-rod mill products) and exported 137,000 t. Net imports fell to 133,000 t, which were down from 171,000 t in 2001 and 220,000 t in 2000. Canada and Mexico accounted for 81% of semifabricated copper exports and 29% of imports. Germany, which was the largest source of imports, accounted for 22% of the total.

U.S. imports of wire rod grew to 249,000 t in 2002 from 108,000 t in 1998. In 1998, Canada accounted for 64% of imports and Mexico for essentially all of the balance. By 2001, imports had risen to 222,000 t and were still dominated by Canada (51%) and Mexico (42%). In 2002, however, according to U.S. Census Bureau data (adjusted to account for misclassification of shipments from Russia), Russia and Brazil emerged as major sources and accounted for 15% and 11%, respectively, of wire-rod imports (table 17). While Canada maintained its market share at 52%, imports from Mexico fell to only 22% of the total.

Chile and the United States completed negotiations on a free trade agreement (FTA) in a final-round meeting in December. More than 90 Chilean negotiators and 140 U.S. negotiators (representing 19 U.S. agencies) met for 9 days to complete the agreement. Chile and the United States began bilateral negotiations on the FTA in December 2000 and held a series of 14 negotiating rounds with teams of specialists who met alternately in Santiago, Chile, and cities in the United States. Although the eventual elimination of the 1% tariff on refined copper imported into the United States was anticipated, details on specifics were not released. Technical details remained to be clarified before the President signs the FTA and Congress passes implementing legislation (Office of the United States Trade Representative, 2003).

World Review

The global production surplus of refined copper, which developed in midyear 1997 and faltered only in 2000, continued into early 2002. By yearend, however, a nearly balanced market had emerged. According to the International Copper Study Group (2003a, p. 19), reported global inventories of refined copper rose to 2.29 Mt in August, which is the period of traditional weak demand, before declining slightly to 2.16 Mt at yearend. This was an increase of about 87,000 t compared with yearend 2001. This contrasts sharply with 2001 when world inventories climbed by more than 750,000 t. World production of refined copper fell by 220,000 t while world refined usage grew by about 300,000 t (International Copper Study Group, 2003a, p. 7). The net effect was to bring production and use into closer balance. With the exception of Asia, the major copper consuming regions of the world reported lower refined copper

use for the second consecutive year. In Asia, where copper use grew by more than 760,000 t (12%), all copper-consuming countries increased their use of copper. Growth in apparent use was led by China with 400,000 t (16%); Taiwan, 115,000 t (21%); the Republic of Korea, 65,000 t (8%); and Indonesia, 45,000 t (41%).

Mine Production.—In 2002, estimated world mine capacity rose by about 650,000 t/yr (4.5%) to about 15.7 Mt/yr, which extended the strong growth trend that began in 1995. South America and Indonesia accounted for most of the increase in capacity. The increased capacities came from expansion of existing facilities or achievement of a full year's production from capacity expansions in 2001. Mine production failed to keep pace with capacity increases principally owing to the conscious action of BHP Billiton to reduce output at its mines in Chile and Peru. In November 2001, the company first announced its intention to reduce output at its Escondida and Tintaya mines, which would reduce production by 170,000 t. In May 2002, it extended the production cut, which effectively reduced production by a total of 250,000 t for the period from November 2001 through December 2002 (BHP Billiton, 2002b).

In Chile, despite the announced cutback in output, production at Escondida declined by only 20,000 t to a level of 755,000 t owing to completion of the \$1 billion Phase 4 expansion in October. The expansion increased total concentrate capacity by 400,000 t/yr, and capacity at the oxide plant, by 8% to 150,000 t/yr. Total production capacity of 1.2 million metric tons per year (Mt/yr) was projected for a 5-year period. Mill throughput actually increased by 8% to 46.5 Mt, but copper in concentrate production fell by 3% to 623,000 t owing to a drop in average mill-head ore grades to 1.58% copper from 1.81% copper (Rio Tinto plc, 2003, p. 42).

Production by Corporación Nacional del Cobre de Chile (Codelco) declined by 4% (70,000 t) to 1.63 Mt. Production at the Radomiro Tomic Division rose by 37,000 t, which exceeded its post expansion capacity projections of 272,000 t/yr. Production at the Chuquicamata Mine, which along with Rodomiro Tomic constituted Codelco's new Norte Division, fell by 45,000 t to 597,000 t. Production from the Andina, El Teniente, and Salvador Divisions fell by 34,000 t, 11,000 t, and 8,000 t, respectively (Corporación Nacional del Cobre de Chile, 2003, p. 36-43).

At El Abra Mine (Phelps Dodge, 51%, and Codelco, 49%), a \$70 million project to leach uncrushed run-of-mine ore was completed in 2001, and production began in January 2002; full production was achieved in the second half of the year. Production in 2002 rose by about 8,000 t to 225,000 t (Phelps Dodge Corp., 2003, p. 7-11).

In Peru, only negligible quantities of copper in concentrate were produced at the Tintaya Mine. Production from Tintaya's new leach project, which began operating at midyear, rose to 8,900 t in the fourth quarter of 2001 and totaled 17,300 t for the year. In northern Peru, the Antamina copper-zinc project (BHP Billiton, Mitsubishi Corp., Noranda Inc., and Teck Cominco Ltd.) achieved commercial production (defined as 80% of design capacity) during the fourth quarter of 2001. In 2002, it produced almost 320,000 t of copper in concentrate, up from 78,000 t in 2001, exceeding its projected capacity of 306,000 t (BHP Billiton, 2003§). Despite an investment of \$352 million in 2001 by SPCC to expand production at its Cuajone and Toquepala mines, production rose only nominally in 2002. Cuajone produced 153,000 t of copper in concentrate, up from 150,000 t in 2001, and Toquepala's production (electrowon copper plus copper in concentrate) was essentially unchanged at 162,000 t. Cash costs, however, reportedly declined by 9.1 cents per pound (Grupo México, S.A. de C.V., 2003, p. 11-13).

In Indonesia, production from the Batu Hijau copper-gold mine, which was commissioned during the fourth quarter of 1999, was essentially unchanged at 298,000 t. Copper production costs reportedly declined by 16% to \$0.31 per pound of copper as the result of operational improvements. Reserves at Batu Hijau rose by 16% to 3.93 Mt of contained copper (Newmont Mining Corp., 2003, p. 29). At the Grasberg Complex, production rose to 864,000 t of copper in concentrate compared with 749,000 t the previous year owing to a 14% improvement in mill-head grade to 1.14% copper. Production from the deep ore zone achieved design capacity of 25,000 t/d 1 year earlier than anticipated. Despite a 12% decline in gold grades, net cash costs amounted to only \$0.08 per pound of copper (Freeport-McMoRan Copper & Gold Inc., 2003, p. 1-18).

In Zambia, production from First Quantum Minerals Ltd.'s (Canada) wholly owned Bwana Mkuba facilities rose to almost 12,000 t of electrowon copper, which was up from 9,700 t the previous year. Commissioned in 1998 at a cost of about \$30 million, the facilities had a reported cash operating cost of \$0.27 per pound of copper. In 2002, the 10,000-t/yr electrowinning plant was modified and expanded to process high-grade ore from the Lonshi copper deposit in the neighboring Congo (Kinshasa). Production was anticipated to rise to 29,000 t in 2003. In the 13-month period ending December 31, Lonshi produced 951,000 t of high-grade ore grading 5.42% acidsoluble copper and 224,000 t of ore grading 0.88% acid-soluble copper. In mid-2002, First Quantum reduced its interest in Mopani Copper Mines to 16.9% from 49%. Combined production from Mopani's Mufulira and Nkana Divisions rose to 111,000 t, which was up from 83,000 t in 2001 and 46,000 t in 2000 (First Quantum Minerals, Ltd., 2003, p. 18-28).

In December, First Quantum completed a feasibility study for the phase I (years 1-16) development of the Kansanshi project. Phase I will focus on the open pit mining of shallow oxide, mixed ores, and sulfide ores. These reserves were estimated to be 142 Mt and contain an average of 1.43% copper. The planned ore-treatment facilities will be flexible, which will allow for variations in ore type. In the first 3 years of operation, production of up to 60,000 t/yr of electrowon cathode and 75,000 t/yr of copper in concentrate is anticipated. Capital costs were estimated to be \$163 million and cash production costs to be \$0.36 per pound of copper. The company anticipated completing financial arrangements and development agreements with the Government of Zambia in 2003 (First Quantum Minerals, Ltd., 2003, p. 28-29).

Non-Ferrous China (NFC) Africa Mining Plc (85% owned by the Chinese parastatal China Nonferrous Materials Industry Engineering and Construction Group) continued to develop and purchase mining equipment for its \$200 million Chambishi Mine Project. NFC Africa Mining acquired its interest from Zambia Consolidated Copper Mines Ltd. in June 1998 for \$20 million. Rehabilitation work on the underground mine and surface facilities began in July 2000 and startup of mining is anticipated in 2003. At full capacity, NFC Africa Mining anticipated mining 2.15 Mt/yr of ore by a combination of cut and fill and sublevel stopping. The mill is anticipated to produce 45,000 t/yr of copper in concentrates containing an average of 40% copper. Chambishi ore reserves were reported to be 33 Mt with additional resources of more than 100 Mt (George Coakley, Country Specialist, U.S. Geological Survey, written commun., September 29, 2003).

Smelter Production.—Despite the continued decline in North American smelting capacity, world smelter capacity rose by about 120,000 t to a record high 14.8 Mt/yr. In Canada, Noranda, Inc. first announced the temporary closure of its Gaspé smelter in Quebec in November 2001 (effective the end of April) and then announced its permanent closure. The smelter, which had operated as a custom smelter, produced 109,000 t of anode in 2001 following the closure of associated mines in 1999 (Noranda, Inc., 2002a). A strike at Noranda's Horne smelter, which began in June 2002 and continued into 2003, further curtailed Canadian smelter output (Noranda, Inc., 2002b). With closure of the Gaspé smelter, smelting capacity in North America fell to 2.01 Mt/yr in 2002 from 3.11 Mt/yr in 1998.

Most of the global smelter expansion took place in China and India, where capacity in 2002 increased by more than 200,000 t and 60,000 t, respectively (International Copper Study Group, 2003b, p. 62-76). In China, expansions of the Guixi (Jiangxi Copper Corp.) and Tongdu (Tongling Nonferrous Metals Corp.) flash smelters and the Yunnan (Yunnan Copper Industry Group) Isasmelt furnace and the restart of the Shenyang (Shenyang Xinxing Copper Co.) blast furnace accounted for most of the capacity increase. In India, the Birla Group smelter was installing Ausmelt technology to expand its Outokumpu furnace to an eventual 250,000 t/yr from 120,000 t/yr in 2001. The Sterlite Industries Ltd. Isasmelt smelter, which started up in 1996, reached full capacity of about 150,000 t/yr.

Despite a decline in world concentrate production, world primary and secondary smelter production remained essentially unchanged in 2002. The supply of copper concentrates from new mine production was insufficient to meet smelter demand for the second consecutive year (CRU International Ltd., 2003, p. 58-61). Yearend 2002 inventories of copper concentrate fell by about 115,000 t compared with 2001 when they had declined by about 250,000 t from yearend 2000. In response to the continued concentrate shortage, annual contractual treatment and refining charges declined by about 2 cents per pound to 17.9 cents per pound of copper. Owing to the growing tightness in supply for copper concentrates, spot treatment and refining charges were reported to have fallen below 6 cents per pound, which was down from 15 cents per pound at yearend 2001. Growing Chinese demand and the limited growth in global production of copper concentrates during the preceding years appeared to be driving the downward spiral in the spot market. Chinese imports of copper in concentrate grew to 620,000 t in 2002 from 375,000 t in 1999.

Refinery Production.—World refinery capacity rose by about 550,000 t/yr (3%), principally owing to expansion of electrowinning capacity in Chile (100,000 t/yr), Peru (35,000 t/yr), and Zambia (25,000 t/yr); expanded electrolytic refining in

China and India that paralleled the growth in smelter capacity; and small incremental increases at refineries in other countries. No new electrolytic refineries were commissioned in 2002, and for the most part, expansions followed expanded smelter capacities (International Copper Study Group, 2003b, p. 59-79). In Spain, Atlantic Copper, S.A. set new production records at its Huevla facility and reported the sale of more than 250,000 t of refined copper (Freeport-McMoRan Copper & Gold Inc., 2003, p. 11).

Outlook

U.S. mine production is expected to decline by about 20,000 t to 1.12 Mt in 2003. Production cutbacks from prior years are expected to be carried forward. Moreover, Asarco further reduced production at its Mission Mine at the beginning of 2003 to about 22,000 t/yr, which decreased its operating rate to just 15% of capacity. Asarco's cutback also affected downstream operations at the company's Hayden smelter and its Amarillo refinery (ASARCO Incorporated, 2002c). Asarco, however, was granted permission by the DOJ to sell its interest in SPCC. Refinery production is anticipated to decline by more than 150,000 t owing to an anode shortage caused by reduced concentrate production, imports, and a temporary smelter shutdown early in the year.

Based on USGS data for the first 6 months of 2003, the slump in domestic consumption of brass and wire mill products was expected to continue through 2003 owing to weakness in commercial construction, telecommunications, and numismatic markets.

According to preliminary data compiled by the International Copper Study Group (2003b, p. 9, 10), world mine production resumed its upward trend in 2003 despite production cutbacks at mines in the United States, Chile, and Peru announced early in the year that were intended to help reduce global oversupply. Chile was expected to account for most of the increase in global mine production and capacity, principally owing to the Phase 4 expansion of its Escondida Mine. According to International Copper Study Group (2003a, p. 7) preliminary data, however, global production of refined copper for the first 7 months of 2003 declined by more than 150,000 t compared with the same period in 2000. World use of refined copper, which was buoyed by a 16% rise in apparent use in China, increased by about 275,000 t during the same comparative periods. As a result, the production surplus of the preceding years was reversed, and reported global inventories declined by about 300,000 t. Copper prices rose accordingly; in September the COMEX spot price averaged \$0.82 per pound, which was the highest level since February 2001.

References Cited

- American Bureau of Metal Statistics, Inc., 2003a, U.S. copper rod market— ABMS report 4: Chatham, NJ, American Bureau of Metal Statistics, Inc., May 14, 6 p.
- American Bureau of Metal Statistics, Inc., 2003b, World brass mills report— ABMS report 3: Chatham, NJ, American Bureau of Metal Statistics, Inc., August 27, 8 p.
- American Metal Market, 2002a, Asarco agrees to keep SPCC until Oct. 17: American Metal Market, v. 110, no. 86-2, September 17, p. 2.

- American Metal Market, 2002b, Court action blocks sale of Asarco stake in SPCC until at least Sept. 30: American Metal Market, v. 110, no. 81-4, August 15, p. 4.
- ASARCO Incorporated, 2001, Asarco announces additional curtailment at Mission Mine and reduces refinery production due to smelter closure: Phoenix, AZ, ASARCO Incorporated press release, November 30, 2 p.
- ASARCO Incorporated, 2002a, Asarco response to Justice Department action: Phoenix, AZ, ASARCO Incorporated press release, August 9, 1 p.
- ASARCO Incorporated, 2002b, Asarco submits environmental proposal to the Department of Justice: Phoenix, AZ, ASARCO Incorporated press release, August 30, 2 p.
- ASARCO Incorporated, 2002c, Asarco to reduce Mission unit copper production to 15 percent of total capacity: Phoenix, AZ, ASARCO Incorporated press release, December 20, 1 p.
- ASARCO Incorporated, 2003, Asarco and Justice Department reach agreement on transaction: Phoenix, AZ, ASARCO Incorporated press release, January 30, 2 p.
- BHP Billiton Base Metals, 2001, BHP Billiton Base Metals reduces metal production: London, United Kingdom, BHP Billiton Base Metals news release, November 8, 1 p.
- BHP Billiton, 2002a, BHP Billiton announces extension to copper cutbacks: London, United Kingdom, BHP Billiton news release, December 4, 1 p.
- BHP Billiton, 2002b, BHP Billiton extends copper production cuts: London, United Kingdom, BHP Billiton news release, May 28, 2 p.
- BHP Billiton, 2003, BHP production report for the quarter ending December 31, 2002: London, United Kingdom, BHP Billiton news release, January 29, 19 p.
- Constellation Copper Corp., 2003, Annual report 2002: Denver, CO, Constellation Copper Corp., 45 p.
- Copper and Brass Fabricators Council Inc., 2003, Import/export report: Washington, DC, Copper and Brass Fabricators Council Inc., 20 p.
- Copper Development Association Inc., 2003, Annual data 2002—Copper supply and consumption: New York, NY, Copper Development Association Inc., 21 p.
- Corporación Nacional del Cobre de Chile, 2003, Annual report 2002: Santiago, Chile, Corporación Nacional del Cobre de Chile, 182 p.
- CRU International Ltd., 2003, Copper quarterly industry and market outlook: London, United Kingdom, CRU International Ltd., July, 80 p.
- First Quantum Minerals, Ltd., 2003, Annual report 2002: Vancouver, British Columbia, Canada, First Quantum Minerals, Ltd., 56 p.
- Freeport-McMoran Copper & Gold Inc., 2003, Annual report 2002: New Orleans, LA, Freeport McMoran Copper & Gold Inc., 68 p.
- Grupo México, S.A. de C.V., 2003, 2002 annual report: Mexico City, Mexico, Grupo México, S.A. de C.V., 23 p.
- International Copper Study Group, 2003a, Copper bulletin: Lisbon, Portugal, International Copper Study Group, v. 10, no. 10, October, 48 p.
- International Copper Study Group, 2003b, Directory of copper mines and plants: Lisbon, Portugal, International Copper Study Group, April, 106 p.
- Newmont Mining Corp., 2003, Annual report 2002: Denver, CO, Newmont Mining Corp., 52 p.
- Noranda, Inc., 2002a, Noranda to permanently close Gaspé copper smelter: Murdochville, Quebec, Canada, Noranda Inc. press release, March 28, 3 p.
- Noranda Inc., 2002b, Strike at Noranda's copper smelter in Rouyn-Noranda: Toronto, Ontario, Canada, Noranda Inc. press release, June 19, 1 p.
- Office of the United States Trade Representative, 2003, United States and Chile sign historic trade agreement: Washington, DC, Office of the United States Trade Representative press release, June 4, 4 p.
- Olin Corporation, 2002, Olin announces possible restructuring charges— Reaffirms earnings guidance excluding potential charges: Norwalk, CT, Olin Corporation press release, December 17, 1 p.
- Olin Corporation, 2003, Olin to close Indianapolis plant: Norwalk, CT, Olin Corporation press release, January 10, 1 p.
- Phelps Dodge Corp., 2001, Phelps Dodge addresses current economic
- environment: Phoenix, AZ, Phelps Dodge Corp. news release, October 23, 3 p. Phelps Dodge Corp., 2002a, Phelps Dodge to construct \$40 million concentrate
- leaching demonstration plant at Bagdad—Operation is first of its kind in western hemisphere: Phoenix, AZ, Phelps Dodge Corp. news release, February 6, 1 p. Phelps Dodge Corp., 2002b, Phelps Dodge Wire and Cable Group to consolidate
- operations, improve efficiencies: Phoenix, AZ, Phelps Dodge Corp. news release, September 10, 2 p.
- Phelps Dodge Corp., 2003, Annual report 2002: Phoenix, AZ, Phelps Dodge Corp., 186 p.
- Pisculli, Alysson, 2002, Kennecott sets second round with mediator: American Metal Market, v. 110, no. 96-2, November 26, p. 1, 3.
- Platts Metals Week, 2002a, Asarco stripping ore at Ray Mine after July halt: Platts Metals Week, v. 73, no. 35, September 2, p. 2-3.

- Platts Metals Week, 2002b, Cerro mill closure eliminates another scrap consumer: Platts Metals Week, v. 73, no. 36, September 9, p. 14.
- Platts Metals Week, 2002c, Duration of Cananea closure key to market move: Platts Metals Week, v. 73, no. 23, June 10, p. 1, 5.
- Platts Metals Week, 2002d, Kennecott plans to keep producing if strike hits: Platts Metals Week, v. 73, no. 39, September 30, p. 5-6.
- Platts Metals Week, 2002e, SPCC strike, Asarco news lift copper market: Platts Metals Week, v. 73, no. 44, November 4, p. 1, 8.
- Platts Metals Week, 2002f, US tries to stop Asarco sale of Southern Peru Copper: Platts Metals Week, v. 73, no. 32, August 12, p. 14.
- Rio Tinto ple, 2003, Annual report and financial statements: London, United Kingdom, Rio Tinto ple, 140 p.
- Superior TeleCom Inc., 2001, Superior Essex Torreón, Mexico, manufacturing facility approved for magnet wire shipments by Emerson: Fort Wayne, IN, Superior TeleCom Inc. press release, April 9, 2 p.
- U.S. Environmental Protection Agency, 2002a, EPA announces improvements to new source review program: U.S. Environmental Protection Agency press release, November 22, 3 p.
- U.S. Environmental Protection Agency, 2002b, National emission standards for hazardous air pollutants for primary copper smelting: Federal Register, v. 67, no. 113, June 12, p. 40478-40506.
- U.S. Environmental Protection Agency, 2002c, National primary drinking water regulations; announcement of the results of EPA's review of existing drinking water standards and request for public comment: Federal Register, v. 67, no. 74, April 17, p. 19030-19090.
- U.S. Environmental Protection Agency, 2002d, Whitman announces transition from consumer use of treated wood containing arsenic: U.S. Environmental Protection Agency press release, February 12, 1 p.
- U.S. Environmental Protection Agency, 2003, EPA finalizes voluntary cancellation of virtually all residential uses of CCA-treated wood: U.S. Environmental Protection Agency press release, March 20, 6 p.
- U.S. Geological Survey, 2000, 1998 assessment of undiscovered deposits of gold, silver, copper, lead, and zinc in the United States: U.S. Geological Survey Circular 1178, 21 p.

Internet References Cited

- BHP Billiton, 2003, BHP Billiton quarterly production report December 2002, accessed June 22, 2003, via URL http://www.bhpbilliton.com/bb/home/ home.jsp.
- Nord Resources Corp., 2003, Johnson Camp Mine, accessed August 22, 2003, at URL http://www.nordresources.com/pages/johnson.html.
- Rebhahn, Peter, 2002, Crandon mine project dropped, Green Bay Press-Gazette, September 17, accessed February 12, 2003, via URL http://www.greenbaygazette.com.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- Copper. Ch. in Metal Prices in the United States Through 1998.
- Copper. Ch. in Mineral Commodity Summaries, annual.
- Copper. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
- Copper. Mineral Industry Surveys, monthly.
- Nature and Use of Copper Reserve and Resource Data, The. Professional Paper 907-F, 1981.

Other

- Availability of Copper in Market Economy Countries, The. U.S. Bureau of Mines Information Circular 9310, 1992.
- Copper. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
- Non-Ferrous Metal Data. American Bureau of Metal Statistics.
- World Metal Statistics. World Bureau of Metal Statistics, monthly.

TABLE 1 SALIENT COPPER STATISTICS¹

(Metric tons unless otherwise specified)

	1998	1999	2000	2001	2002
United States:					
Mine production:					
Ore concentrated thousand metric tons	268,000	236,000	202,000	148,000	104,000
Average yield of copper ² percent	0.46	0.42	0.43 ^r	0.47 ^r	0.51
Recoverable copper:	1 100 000	1 0 5 0 0 0 0			
Arizona	1,190,000	1,050,000	929,000	879,000	767,000
Michigan, Montana, Utah	337,000	313,000	W	W	W
New Mexico	252,000	197,000	195,000	141,000	112,000
Other States	78,900	37,400	322,000 r	318,000	263,000
Total Total value millions	1,860,000	1,600,000 \$2,680	1,450,000	1,340,000	1,140,000
Total value millions Smelter production:	\$3,220	\$2,080	\$2,810	\$2,270	\$1,910
From domestic and foreign ores	1 400 000	1 000 000	(3)	(3)	(3)
From scrap (new and old)	1,490,000 232,000	1,090,000 205,000	(3)	(3)	(3)
Total	1,720,000	1,290,000	1,000,000	919,000	683,000
Byproduct sulfuric acid, sulfur content thousand metric tons	1,720,000	1,290,000	830	813	695
Refinery production:	1,420	1,150	850	615	095
Primary materials:					
Electrolytic from domestic ores	1,290,000	1,110,000	865,000	808,000	725,000
Electrolytic from foreign materials	238,000	196,000	163,000	192,000	116,000
Electrowon	609,000	586,000	566,000	628,000	601,000
Total	2.140.000	1,890,000	1,590,000	1.630.000	1,440,000
Secondary materials (scrap):		-,	-,	-,,	-,,
Electrolytic	202,000	156,000	(3)	(3)	(3)
Fire refined	147,000	73,700	(3)	(3)	(3)
Total	349,000	230,000	208,000	172,000	69,900
Grand total	2,490,000	2,120,000	1,800,000	1,800,000	1,510,000
Secondary copper produced:					
Recovered from new scrap	956,000	949,000	955,000	833,000	842,000
Recovered from old scrap	466,000	381,000	357,000	316,000	207,000
Total	1,420,000	1,330,000	1,310,000	1,150,000	1,050,000
Copper sulfate production	44,000	52,700	55,500	55,200	49,200
Exports:					
Refined	86,200	25,200	93,600	22,500	26,600
Unmanufactured ⁴	412,000	395,000	650,000	556,000	506,000
Imports:					
Refined	683,000	837,000	1,060,000	991,000	927,000
Unmanufactured ⁴	1,190,000	1,280,000	1,350,000	1,400,000	1,230,000
Copper stocks, December 31:					
Blister and in-process material	160,000	138,000	122,000	98,000	44,400
Refined copper:					
Refineries	44,200	9,830	14,800	28,600	11,700
Wire-rod mills	37,300	32,500	28,600	37,600 ^r	23,000
Brass mills	20,800	23,800	23,600	25,500	28,700
Other industry	3,870	3,870	4,680	4,860 ^r	3,600
New York Commodity Exchange (COMEX)	85,200	83,100	58,700	244,000	362,000
London Metal Exchange (LME), U.S. warehouses	341,000	412,000	204,000	617,000	601,000
Total	532,000	565,000	334,000	957,000 r	1,030,000
Consumption:	• • • • • • • •	• • • • • • • •	2 020 000		
Refined copper, reported	2,890,000	2,980,000	3,030,000	2,620,000	2,370,000
Apparent consumption, primary refined and old scrap ⁵ Price:	3,030,000	3,130,000	3,130,000	2,500,000	2,610,000
Producer, weighted average cents per pound	78.64	75.91	88.16	76.85	75.80
COMEX, first position do.	75.08	72.11	83.97	72.57	71.67
LME, Grade A cash do.	75.01	71.33	82.24	71.57	70.72
World, production:					
Mine thousand metric tons	12,100	12,800 ^r	13,200	13,700	13,600 ^e
	,	11,700 ^r	11,000 r	11,500 ^r	11,500 °
Smelter do.	11,300 ^r	11,700	11,000	11,500	11,500

See footnotes at end of table.

TABLE 1--Continued SALIENT COPPER STATISTICS¹

"Estimated. Revised. W Withheld to avoid disclosing company proprietary data; included in "Other States."

¹Data are rounded to no more than three significant digits, except prices; may not add to totals shown.

²Yield calculations are for concentrated ore only.

³Withheld to avoid disclosing company proprietary data; included in "Total."

⁴Includes copper content of alloy scrap.

 5 In 1998, 1999, 2000, 2001, and 2002, apparent consumption is calculated using general imports of 725,000 metric tons (t), 915,000 t, 1,020,000 t, 1,200,000 t, and 1,060,000 t, respectively.

TABLE 2 LEADING COPPER-PRODUCING MINES IN THE UNITED STATES IN 2002, IN ORDER OF OUTPUT¹

					Capacity
					(thousand
Rank	Mine	County and State	Operator	Source of copper	metric tons)
1	Morenci	Greenlee, AZ	Phelps Dodge Corp.	Copper ore, leached	390
2	Bingham Canyon	Salt Lake, UT	Kennecott Utah Copper Corp.	Copper-molybdenum ore, concentrated	300
3	Ray Mines	Pinal, AZ	ASARCO Incorporated	Copper ore, concentrated and leached	180
4	Bagdad	Yavapai, AZ	Phelps Dodge Corp.	Copper-molybdenum ore, concentrated and leached	120
5	Sierrita	Pima, AZ	do.	do.	120
6	Tyrone	Grant, NM	do.	Copper ore, leached	95
7	Chino	do.	do.	do.	125
8	Mission Complex	Pima, AZ	ASARCO Incorporated	Copper ore, concentrated	70
9	Silver Bell	do.	do.	Copper ore, leached	22
10	Miami Mine	Gila, AZ	Phelps Dodge Corp.	do.	75
11	Pinto Valley	do.	BHP Copper Co.	do.	10
12	Miami	do.	do.	do.	12

¹The mines in this list accounted for 99% of the U.S. mine production in 2002.

TABLE 3

MINE PRODUCTION OF COPPER-BEARING ORES AND RECOVERABLE COPPER CONTENT OF ORES PRODUCED IN THE UNITED STATES, BY SOURCE AND TREATMENT PROCESS¹

(Metric tons)

	200)1	20	02
	Gross	Recoverable	Gross	Recoverable
Source and treatment process	weight	copper	weight	copper
Mined copper ore:				
Concentrated	148,000,000 2	707,000	104,000,000	535,000
Leached	NA	624,000	NA	601,000
Total	NA	1,330,000	NA	1,140,000
Copper precipitates shipped, leached from	-			
tailings, dumps, and in-place material	1,570	936	950	536
Other copper-bearing ores ³	5,390,000 r	6,870	3,330,000	6,550
Grand total	XX	1,340,000	XX	1,140,000

^rRevised. NA Not available. XX Not applicable.

¹Data rounded to three significant digits; may not add to totals shown.

²In 2002, 12,500 kilograms of gold and 167 metric tons of silver were recovered from concentrated ore. The average value of gold and silver per metric ton of ore concentrated was \$1.45.

³Includes gold ore, lead ore, silver ore, silver-copper ore, zinc ore, and ore shipped directly to smelter.

TABLE 4

CONSUMPTION OF COPPER AND BRASS MATERIALS IN THE UNITED STATES, BY ITEM¹

(Metric tons)

			Foundries, chemical plants,	Smelters, refiners,	_
Item	Brass mills	Wire-rod mills	miscellaneous users	ingot makers	Total
2001:					
Copper scrap	919,000 ²	W	87,500 ^r	371,000	1,380,000
Refined copper ³	623,000	1,940,000	51,400	4,590	2,620,000
Hardeners and master alloys	528		1,980 ^r		2,510 r
Brass ingots			112,000 ^r		112,000 ^r
Slab zinc	51,700		(4)	(4)	73,600 ^r
2002:					
Copper scrap	930,000 ²	W	86,900	240,000	1,260,000
Refined copper ³	593,000	1,710,000	63,000	4,570	2,370,000
Hardeners and master alloys	554		2,450		3,010
Brass ingots			100,000		100,000
Slab zinc	67.900		(4)	(4)	85,600

^rRevised. W Withheld to avoid disclosing company proprietary data; included with "Brass mills." -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes item indicated by symbol W.

³Detailed information on consumption of refined copper can be found in table 5.

⁴Withheld to avoid disclosing company proprietary data; included in "Total."

TABLE 5 CONSUMPTION OF REFINED COPPER SHAPES IN THE UNITED STATES, BY CLASS OF CONSUMER¹

(Metric tons)

		Ingots and	Cakes and	Wirebar, billets,	
Class of consumer	Cathodes	ingot bars	slabs	other	Total
2001:					
Wire-rod mills	1,930,000			12,600	1,940,000
Brass mills	429,000	18,400	95,900	80,000	623,000
Chemical plants				1,190	1,190
Ingot makers	W	W	W	4,590 ²	4,590
Foundries	2,840 ^r	5,570 ^r		13,200 ^r	21,600 r
Miscellaneous ³	W	W	W	28,600 ^{r, 2}	28,600 r
Total	2,360,000	24,000	95,900	140,000 ^r	2,620,000
2002:					
Wire-rod mills	1,700,000			8,710	1,710,000
Brass mills	439,000	17,700	72,600	63,700	593,000
Chemical plants				954	954
Ingot makers	W	W	W	4,570 ²	4,570
Foundries	2,840	11,600		11,900	26,400
Miscellaneous ³	W	W	W	35,700 ²	35,700
Total	2,140,000	29,300	72,600	126,000	2,370,000

^rRevised. W Withheld to avoid disclosing company proprietary data; included with "Wirebar, billets, other." -- Zero. ¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes items indicated by symbol W.

³Includes consumers of copper powder and copper shot, iron and steel plants, and other manufacturers.

TABLE 6 COPPER RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES, BY KIND OF SCRAP AND FORM OF RECOVERY 1

(Metric tons)

	2001	2002
Kind of scrap:		
New scrap:	-	
Copper-base	795,000	805,000
Aluminum-base	38,300 r	37,100
Nickel-base	18	18
Total	833,000	842,000
Old scrap:		
Copper-base	292,000	183,000
Aluminum-base	24,000	24,000
Nickel-base	173	178
Zinc-base	29	29
Total	316,000	207,000
Grand total	1,150,000	1,050,000
Form of recovery:		
As unalloyed copper	180,000	77,700
In brass and bronze	893,000 ^r	896,000
In alloy iron and steel	506 ^r	449
In aluminum alloys	64,000 ^r	62,700
In other alloys	117 ^r	117
In chemical compounds	11,200	12,200
Total	1,150,000	1,050,000

^rRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 7

COPPER RECOVERED AS REFINED COPPER AND IN ALLOYS AND OTHER FORMS FROM COPPER-BASE SCRAP PROCESSED IN THE UNITED STATES, BY TYPE OF OPERATION¹

(Metric tons)

	From new	From new scrap		From old scrap		ıl
Type of operation	2001	2002	2001	2002	2001	2002
Ingot makers	28,200 r	28,100	94,400 r	90,600	123,000 r	119,000
Refineries ²	35,800	36,500	137,000	33,400	172,000	69,900
Brass and wire-rod mills	707,000	716,000	19,800	18,700	727,000	735,000
Foundries and manufacturers	18,600	19,200	38,600 r	37,200	57,300 ^r	56,400
Chemical plants	5,120	5,070	2,960	2,960	8,080	8,040
Total	795,000	805,000	292,000	183,000	1,090,000	988,000

Revised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Electrolytically refined based on source of material at smelter level.

TABLE 8

PRODUCTION OF SECONDARY COPPER AND COPPER-ALLOY PRODUCTS IN THE UNITED STATES, BY ITEM PRODUCED FROM SCRAP¹

(Metric tons)

Item produced from scrap	2001	2002
Unalloyed copper products:		
Refined copper	172,000	69,900
Copper powder	7,450	7,440
Copper castings	323	300
Total	180,000	77,700
Alloyed copper products:		
Brass and bronze ingots:		
Tin bronzes	14,300	15,300
Leaded red brass and semired brass	87,100 ^r	87,900
High leaded tin bronze	11,000	10,500
Yellow brass	5,980	6,610
Manganese bronze	9,510	10,000
Aluminum bronze	7,100	7,010
Nickel silver	2,450	2,040
Silicon bronze and brass	4,780	4,540
Copper-base hardeners and master alloys	11,300	6,630
Miscellaneous	3,640	4,490
Total	157,000 r	155,000
Brass mill and wire-rod mill products	905,000	916,000
Brass and bronze castings	45,000 r	44,000
Brass powder	182	123
Copper in chemical products	11,200	12,200
Grand total	1,300,000 r	1,210,000

^rRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 9 COMPOSITION OF SECONDARY COPPER-ALLOY PRODUCTION IN THE UNITED STATES¹

(Metric to	ons)
------------	------

	Copper	Tin	Lead	Zinc	Nickel	Aluminum	Total
Brass and bronze ingot production: ²							
2001	130,000 ^r	5,080 ^r	8,130 ^r	14,100 ^r	263 ^r	16	157,000 ^r
2002	127,000	5,550	8,570	13,600	253	17	155,000
Secondary metal content of brass mill products:							
2001	728,000 ^r	1,690	6,340	167,000	W	W	905,000
2002	736,000	1,450	6,400	171,000	W	W	916,000
Secondary metal content of brass and bronze castings:							
2001	40,600 r	1,440 r	909 r	1,860 ^r	91	94	45,000 r
2002	39,200	1,490	1,100	2,050	78	72	44,000

"Revised. W Withheld to avoid disclosing company proprietary data; included in "Total."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes approximately 97% from scrap and 3% from other than scrap in 2001 and approximately 96% from scrap and 4% from other than scrap in 2002.

TABLE 10

CONSUMPTION AND YEAREND STOCKS OF COPPER-BASE SCRAP¹

(Metric tons, gross weight)

	2001		2002	
Scrap type and processor	Consumption	Stocks	Consumption	Stocks
No. 1 wire and heavy:				
Smelters, refiners, and ingot makers	- 82,700 ^r	1,010 r	74,500	1,030
Brass and wire-rod mills	395,000	(2)	379,000	(2
Foundries and miscellaneous manufacturers	- 34,600 r	(2)	34,000	(2
No. 2 mixed heavy and light:	_			
Smelters, refiners, and ingot makers	103,000	1,370	42,800	1,350
Brass and wire-rod mills	5,340	(2)	6,630	(2
Foundries and miscellaneous manufacturers	3,060	(2)	3,490	(2
Total unalloyed scrap:				
Smelters, refiners, and ingot makers	- 186,000	2,370 r	117,000	2,380
Brass and wire-rod mills	400,000	16,100	386,000	15,800
Foundries and miscellaneous manufacturers	37,700 ^r	2,700	37,400	2,470
Red brass: ³				
Smelters, refiners, and ingot makers	- 47,400 ^r	2,350 r	37,000	2,250
Brass mills	8,990	(2)	13,500	(2)
Foundries and miscellaneous manufacturers	10,900	(2)	9,090	(2
Leaded yellow brass:	-		,	
Smelters, refiners, and ingot makers	- 14,900 r	1,130	13,500	1,120
Brass mills	337,000	(2)	327,000	(2
Foundries and miscellaneous manufacturers	1,340 r	(2)	1,200	(2
Yellow and low brass, all plants	111,000	963 ^r	105,000	904
Cartridge cases and brass, all plants	36,400	(2)	70,900	(2
Auto radiators:	_ `			
Smelters, refiners, and ingot makers	45,400	1,300	39,900	2,000
Foundries and miscellaneous manufacturers	2,840 ^r	(2)	4,770	(2
Bronzes:	_ `			
Smelters, refiners, and ingot makers	- 11,700 ^r	1,200 r	10,100	1,130
Brass mills and miscellaneous manufacturers	20,200	(2)	24,400	(2
Nickel-copper alloys, all plants	19,300	302 r	15,700	245
Low grade and residues:	_			
Smelters, refiners, and miscellaneous manufacturers	70,200 ^r	3,740 ^r	33,000	3,740
Other alloy scrap: ⁴	_ `			
Smelters, refiners, and ingot makers	- 8,460 ^r	283 ^r	3,090	259
Brass mills and miscellaneous manufacturers	6,910	(2)	8,010	(2
Total alloyed scrap:				
Smelters, refiners, and ingot makers	185,000	11,300 r	123,000	11,600
Brass mills	518,000	32,900	544,000	31,300
Foundries and miscellaneous manufacturers	49,800 r	2,570 r	49,400	2,950
Grand total:				
Smelters, refiners, and ingot makers	371,000	13,600 ^r	240,000	14,000
Brass and wire-rod mills	919,000	48,900	930,000	47,100
Foundries and miscellaneous manufacturers	- 87,500 ^r	5,270 r	86,900	5,420

Revised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Individual breakdown is not available; included in "Total unalloyed scrap," "Total alloyed scrap," and "Grand total." ³Includes cocks and faucets, commercial bronze, composition turnings, gilding metal, railroad car boxes, and silicon bronze.

⁴Includes aluminum bronze, beryllium copper, and refinery brass.

TABLE 11 CONSUMPTION OF PURCHASED COPPER-BASE SCRAP^{1, 2}

(Metric tons, gross weight)

	From new scrap		From o	ld scrap	Total	
Type of operation	2001	2002	2001	2002	2001	2002
Ingot makers	44,400 r	41,900	131,000	128,000	175,000	170,000
Smelters and refineries	135,000	36,400	61,300	33,900	196,000	70,300
Brass and wire-rod mills	898,000	910,000	20,400	19,300	919,000	930,000
Foundries and miscellaneous						
manufacturers	41,900	42,300	45,500	44,600	87,500 ^r	86,900
Total	1,120,000	1,030,000	258,000	226,000	1,380,000	1,260,000
Pewised						

^rRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Consumption at brass and wire-rod mills assumed equal to receipts.

TABLE 12

FOUNDRIES AND MISCELLANEOUS MANUFACTURERS CONSUMPTION OF BRASS INGOT, REFINED COPPER AND COPPER SCRAP IN THE UNITED STATES¹

(Metric tons)

Ingot type or material consumed	2001 ^r	2002
Tin bronzes	26,300	25,400
Leaded red brass and semired brass	65,900	58,800
Yellow, leaded, low brass ²	7,740	5,040
Manganese bronze	4,830	6,080
Nickel silver ³	2,730	1,160
Aluminum bronze	3,760	3,460
Hardeners and master alloys ⁴	1,980	2,450
Lead free alloys ⁵	331	316
Total brass ingot	114,000	103,000
Refined copper	51,400	63,000
Copper scrap	87,500	86,900

^rRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown. ²Includes brass and silicon bronze.

³Includes brass, copper nickel, and nickel bronze.

⁴Includes special alloys.

⁵Includes copper-bismuth and copper-bismuth-selenium alloys.

TABLE 13 AVERAGE PRICES FOR COPPER SCRAP AND ALLOY-INGOT, BY TYPE

(Cents per pound)

			Dealers'	buying (New York)
	Brass mills	Refiners	No. 2	Red brass turnings
Year	No. 1 scrap	No. 2 scrap	scrap	and borings
2001	69.57 ^r	58.90 ^r	48.71 ^r	40.77 ^r
2002	70.23	59.45	42.36	37.00

^rRevised.

Source: American Metal Market.

	Ore and concentrate	oncentrate	Matte, ash and J	l precipitates	Refined	hed	Unalloyed copper scrap	opper scrap	Blister and anodes	d anodes	Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Country	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)
2001	45,300	\$62,700	23,900	\$31,200	22,500	\$39,400	262,000	\$294,000	26,000	\$46,600	379,000	\$474,000
2002:												
Australia	21	39	5	L	1,650	3,090	1	1	77	154	1,750	3,290
Belgium	42	74	12	27	ł	ł	2,210	5,540	179	275	2,440	5,910
Canada	17,500	30,800	2,560	3,330	3,130	5,650	20,100	18,900	17,700	21,400	61,000	80,100
China	1,110	1,730	63	36	14,900	26,900	122,000	136,000	515	2,000	139,000	166,000
Egypt	•	1	1	1	2,200	3,580	1	1	1	1	2,200	3,580
Germany	28	51	85	140	62	167	14,200	16,800	241	522	14,600	17,600
Hong Kong	25	44	160	278	38	69	7,180	17,100	2,600	5,500	10,000	23,000
India	6	15	153	141	825	878	3,920	3,920	83	203	4,990	5,160
Japan	36	60	1,330	2,980	48	123	11,000	15,900	40	95	12,500	19,100
Korea, Republic of	197	376	40	64	524	2,150	14,900	21,100	707	1,710	16,300	25,400
Mexico	2,620	4,350	12,400	9,230	135	254	2,280	5,260	38	113	17,500	19,200
Netherlands	38	94	35	50	16	23	232	255	1,100	1,450	1,420	1,870
Peru	1,230	2,030	39	29	1	ł	I	1	1	I	1,270	2,060
Philippines	1	ł	ω	4	3	5	I	I	5,880	10,000	5,880	10,000
Singapore	69	138	(2)	18	7	11	I	I	614	1,210	682	1,380
Spain	•	1	4	13	9	10	109	37	259	549	379	608
Taiwan	80	127	104	258	1,630	2,620	10,100	13,200	1,000	2,150	12,900	18,400
Thailand	7	13	1	1	1	1	1,010	756	317	720	1,340	1,490
United Kingdom	16	29	65	200	527	860	17	90	469	1,060	1,100	2,240
Other	47	93	75	324	858	1,660	3,470	3,610	1,080	2,280	5,530	7,970
Total	23,000	40,100	17,100	17,100	26,600	48,000	213,000	258,000	32,900	51,400	313,000	415,000
Zero.												
¹ Data are rounded to no more than three significant digits: may not add to totals shown	nore than three si	gnificant digits;	may not add to t	totals shown.								

¹Data are rounded to no more than three significant digits; may not add to totals shown. 2 Less than 1/2 unit.

		Pipes and tubing	l tubing	Plates, sheets, foil, bars	s, foil, bars	Bare wire, including wire rod ²	ding wire rod ²	Wire and cal	Wire and cable, stranded	Copper sulfate ³	ulfate ³
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
22,400 \$72,700 $31,800$ $811,000$ $76,400$ $8169,000$ $29,800$ 813 strail 5 32 6 98 3 49 $23,700$ 5000 100 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 $11,700$ 5000 7100 5000 7100 5000 7100 5000 7100 5000 7100 5000 7100 5000 7100 5000 7100 700 7100 7100 7100 7100 7100 7100 7100 7100 7100 7100 7100 7100	Country	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	thousands
ratial 5 32 6 98 3 49 28 ratial $9,770$ $28,100$ $12,200$ $40,400$ $16,300$ $37,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,700$ 5030 $17,7700$ 5030 $11,700$ 5030 $11,7$ 2050 100 503 322 323 100 503 323 2100 $50,700$ 5100 $77,700$ $50,700$ 5100 $77,77$ $72,77$ $72,77$ $72,$	001	22,400	\$72,700	31,800	\$111,000	76,400	\$169,000	29,800	\$136,000	1 020 r	\$869 r
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$:002:										
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Australia	5	32	9	98	ŝ	49	28	632	1	ł
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Canada	9,770	28,100	12,200	40,400	16,300	37,700	5,030	12,700	1,250	1,070
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Chile	4	6	49	136	2	95	32	250	4	8
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	China	335	948	546	1,330	148	461	277	2,080	86	72
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Denmark	1	ł	(4)	13	2	8	5	74	ł	ł
10 20 115 366 $2,420$ 26 367 109 110 110 63 332 228 444 117 110 332 128 47 $1,810$ 4 41 95 39 143 47 $1,810$ 4 41 95 501 $1,350$ 45 427 5 37 45 37 45 501 $1,350$ 45 427 5 37 45 37 45 37 45 37 45 37 45 37 45 37 45 37 45 37 45 393	France	160	834	94	1,470	50	453	81	1,840	1	ł
mg 3 10 63 332 28 444 117 a $ 3$ 2 3 3 3 3 3 2 3 3 3	Germany	20	115	366	2,420	26	367	109	4,210	1	ł
a - - - - (4) 3 2 2 39 143 47 1,810 4 1 95 37 45 501 1,350 45 427 5 37 45 5 22 352 1,820 130 832 391 6 101 422 45 1,780 47 238 903 6 101 422 45 1,780 47 238 903 6 101 422 45 226 4 54 29 123 465 113 529 36 298 567 21 123 465 113 529 36 298 567 21 abia 261 87 0 70 70 7 7 513 786 92 66 217 32 6 197 133 <td< td=""><td>Hong Kong</td><td></td><td>10</td><td>63</td><td>332</td><td>28</td><td>444</td><td>117</td><td>1,510</td><td>63</td><td>58</td></td<>	Hong Kong		10	63	332	28	444	117	1,510	63	58
39 143 47 1,810 4 41 95 501 1,350 45 427 5 37 45 5 5 22 352 1,820 130 832 391 5 22 352 1,820 130 832 391 5 26 125 834 1,780 47 238 903 6 101 422 45 226 4 54 29 10900 36,200 24,300 48,600 74,000 144,000 20,800 7 123 465 113 529 36 298 567 22 123 465 113 529 36 298 567 21 1230 2,560 6 61 $ -$	Indonesia	1	1	1	ł	(4)	ŝ	2	46	1	ł
501 1,350 45 427 5 37 45 5 22 352 1,820 130 832 391 45 5 22 352 1,820 130 832 391 45 6 125 834 1,780 47 238 903 77 101 422 45 226 4 54 29 361 29 100 36,200 24,300 48,600 74,000 144,000 20,800 7 123 465 113 529 36 298 567 22 123 455 113 523 8 70 7 7 $1,230$ $2,560$ 6 61 - - - (4) 70 7 70 7 70 71 4 38 271 29 66 109 33 271 6 10	Israel	39	143	47	1,810	4	41	95	623	4	3
5 22 352 1,820 130 832 391 epublic of 26 125 834 1,780 47 238 903 $(101$ 422 45 226 4 54 29 $(101$ 422 45 226 4 54 29 $(101$ 422 45 113 529 36 298 567 23 (10) 9 70 74,000 144,000 20,800 7 7 (1) 9 70 523 8 70 7 7 (1) 9 70 533 8 70 7 7 (1) 1,230 2,560 6 61 (4) 70 7 (1) 1,230 2,560 6 61 - (4) (1) (1) (2) (2) (2) (2) (2) (2) <	Italy	501	1,350	45	427	5	37	45	742	1	ł
epublic of 26 125 834 1,780 47 238 903 101 422 45 226 4 54 29 101 422 45 226 4 54 29 10300 36,200 24,300 48,600 74,000 144,000 20,800 7 123 465 113 529 36 298 567 22 123 465 113 523 8 70 7 7 $1,230$ 2,560 6 61 - - (4) 7 $1,230$ 2,560 6 61 - - (4) 7 7 201 876 45 173 4 38 271 29 $1,230$ $2,560$ 6 61 $$ - $ (4)$ 38 271 e 6 133	Japan	5	22	352	1,820	130	832	391	2,730	1	ł
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Korea, Republic of	- 26	125	834	1,780	47	238	903	5,060	60	72
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Malaysia	101	422	45	226	4	54	29	234	1	ł
nds 123 465 113 529 36 298 567 23 land (4) 9 70 523 8 70 7 7 2 abia (4) 9 70 533 8 70 7 7 abia 261 876 45 173 4 38 271 e 6 197 133 786 92 668 242 e 6 197 133 786 92 668 242 ingdom 54 269 2534 6 109 33 ingdom 54 269 252 3,140 203 1,360 170 715 2,670 41000 1,2200 3,070 2,670 1 2,670 1	Mexico	10,900	36,200	24,300	48,600	74,000	144,000	20,800	78,200	36	40
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Netherlands	123	465	113	529	36	298	567	28,300	14	11
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	New Zealand	(4)	6	70	523	8	70	7	126	1	ł
abia 261 876 45 173 4 38 271 e 6 197 133 786 92 668 242 e - - 51 534 6 109 33 ingdom 54 269 252 3,140 203 1,360 170 33 ingdom 54 269 252 3,140 203 1,360 170 37,00 2,670 1 24300 7550 4100 10,000 92,400 190,000 37,000 16	Portugal	1,230	2,560	9	61	I	1	(4)	С	1	ł
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Saudi Arabia	261	876	45	173	4	38	271	823	1	1
$\begin{array}{ cccccccccccccccccccccccccccccccccccc$	Singapore	. 6	197	133	786	92	668	242	1,460	23	23
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Sweden	1	1	51	534	9	109	33	398	1	ł
I Kingdom 54 269 252 3,140 203 1,360 170 715 2,670 444 2,600 1,220 3,070 2,670 1 1 24 300 75 500 41 000 112 000 92 400 190 000 37 000 16	Taiwan	10	98	666	2,880	41	195	84	668	1	ł
715 2,670 444 2,600 1,220 3,070 2,670 1 24 300 75 500 41 000 11 000 92 400 190 000 32 000 1	United Kingdom	54	269	252	3,140	203	1,360	170	3,620	5	5
24 300 75 500 41 000 112 000 92 400 190 000 32 000	Other	715	2,670	444	2,600	1,220	3,070	2,670	14,600	84	82
	Total	24,300	75,500	41,000	112,000	92,400	190,000	32,000	161,000	1,650	1,440

U.S. EXPORTS OF COPPER SEMIMANUFACTURES, BY COUNTRY¹ TABLE 15

Kevised. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Total exports of wire rod were 44,100 metric tons (t) valued at \$98,800,000 in 2001 and 55,200 t valued at \$105,000,000 in 2002. ³Previously published copper sulfate export quantity data for 2000 have been revised to \$11 t from 10,274 t, and value data have been revised to \$934 from \$25,092. ⁴Less than 1/2 unit.

TABLE 16 U.S. IMPORTS FOR CONSUMPTION OF UNMANUFACTURED COPPER (COPPER CONTENT), BY COUNTRY¹

	Ore and concentrate	oncentrate	Matte, ash and precipitates	l precipitates	Blister and anode	d anode	Refined	hed	Unalloyed scrap	d scrap	Total	al
	Quantity	Value ²	Quantity	Value ²	Quantity	Value ²	Quantity	Value ²	Quantity	Value ²	Quantity	Value ²
Country	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)
2001	46,500	\$62,100	945	\$1,850	271,000	\$645,000	991,000	\$1,620,000	30,300	\$41,700	1,340,000	\$2,370,000
2002:												
Brazil	:	1	:	1	:	1	45,000	69,600	1	ł	45,000	69,600
Canada	8,350	8,200	75	107	83,700	247,000	235,000	378,000	13,900	22,200	341,000	655,000
Chile	51,800	83,600	:	ł	37,400	56,900	245,000	384,000	611	916	335,000	525,000
Costa Rica	:	1	:	1	:	1	;	1	1,100	973	1,100	973
Dominican Republic	1	ł	:	1	:	1	:	1	1,360	1,260	1,360	1,260
Guatemala	:	1	;	1	:	1	;	1	536	532	536	532
Honduras	:	1	:	1	:	1	:	1	399	518	399	518
Indonesia	2,910	5,720	:	1	:	1	:	1	1	ł	2,910	5,720
Italy	:	1	;	1	:	1	;	1	116	679	116	679
Jamaica	:	1	:	1	:	1	:	1	362	413	362	413
Japan	:	1	2	10	(3)	17	8,640	18,200	79	844	8,730	19,100
Mexico	4	10	324	179	16,200	46,700	57,200	90,000	9,250	8,830	82,900	146,000
Namibia	:	1	:	1	6,340	11,300	:	1	1	ł	6,340	11,300
Nicaragua	1	I	;	ł	;	ł	;	ł	321	428	321	428
Peru	5,960	7,330	1	I	4,730	7,220	288,000	457,000	I	ł	298,000	471,000
Russia	;	1	:	1	:	1	28,800	46,300	1	1	28,800	46,300
Taiwan	17	85	621	1,320	:	1	10	34	15	30	663	1,460
Turkey	2,910	2,260	;	1	:	1	;	1	1	1	2,910	2,260
United Kingdom	:	I	:	I	2	66	3,410	5,380	155	451	3,570	5,930
Other	2	28	17	50	70	34	16,600	31,200	1,020	934	17,700	32,300
Total	71,900	107,000	1,040	1,660	148,000	369,000	927,000	1,480,000	29,300	39,000	1,180,000	2,000,000
Zero.												
¹ Data are rounded to no more than three significant digits; may not add to totals shown	ore than three sig	gnificant digits;	may not add to t	otals shown.								

 $^2 \text{Cost}$, insurance, and freight value at U.S. port. $^3 \text{Less}$ than 1/2 unit.

TABLE 17	U.S. IMPORTS FOR CONSUMPTION OF COPPER SEMIMANUFACTURES, BY COUNTRY ¹
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	•	0				Date will be a substanting will be a sub-	the mild cuote, building	out, sumucu	Copper surrate	Allan
	Quantity	Value ³	Quantity	Value ³	Quantity	Value ³	Quantity	Value ³	Quantity	Value ³
Country	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)	(metric tons)	(thousands)
2001	1,370	\$6,940	101,000	\$319,000	234,000	\$442,000	8,660	\$32,800	40,200 ^r	\$30,200 ^r
2002:										
Belgium	:	1	ŝ	5	53	380	(5)	ŝ	1,060	798
Brazil	(2)	6	838	2,080	34,900	59,300	1	1	13	8
Canada	936	4,950	6,470	18,600	132,000	234,000	693	3,090	5,940	4,870
Chile	15	34	2,880	6,930	43	65	ł	I	96	76
China	:	1	710	2,710	56	242	13	43	7,360	4,950
Finland		188	2,410	8,300	607	2,180	49	328	416	223
France	(5)	36	1,890	4,610	199	1,730	18	332	174	198
Germany	163	717	25,800	66,600	1,460	4,280	406	1,800	63	225
Hong Kong	:	1	54	440	1	1	(5)	13	1	1
India	-	6	337	375	2	21	18	185	ł	ł
Israel	•	1	1	1	5	68	2,150	9,690	20	18
Italy	:	1	3,900	9,260	51	186	1	24	18	12
Japan	(5)	5	5,000	21,500	565	3,610	10	165	43	218
Luxembourg	:	1	2,000	11,800	1	1	3	ŝ	1	1
Malaysia	668	2,230	(5)	2	2	91	1	ŝ	ł	ł
Mexico	:	1	1,550	4,330	53,800	84,700	(5)	ŝ	26,100	19,600
Peru	:	1	3,250	7,130	420	941	346	743	2,170	1,420
Russia	:	1	13,100	22,400	22,000	42,200	1	1	1	1
Sweden	:	1	8,620	26,700	16	246	(5)	ŝ	ł	ł
Taiwan	-	26	211	1,570	91	388	51	290	1,320	815
Turkey	:	1	15	34	5,070	14,100	463	1,410	1	1
United Kingdom	-	25	648	2,950	214	658	8	104	1	1
Other	. 6	65	2,190	6,240	794	2,660	50	311	1,710	1,240
Total	1,810	8,290	81,800	225,000	252,000	453,000	4,280	18,500	46,500	34,700

²Total imports of wire rod were 247,000 metric tons (t) valued at \$502,000,000 in 2001 and 221,000 t valued at \$393,000,000 in 2002. Import data adjusted by the U.S. Geological Survey to correct misclassification of imports from Mexico.

³Cost, insurance, and freight value at U.S. port.

⁴Previously published copper sulfate import quantity data for 2000 have been revised to 33,300 t from 2,550 t, and value data have been revised to \$25,100 from \$9,900.

TABLE 18
U.S. EXPORTS OF COPPER SCRAP, BY COUNTRY ¹

		Unalloyed o	opper scrap			Copper-a	lloy scrap	
	200	01	200	02	200	01	200	02
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Country	(metric tons)	(thousands)						
Belgium	1,260	\$2,860	2,210	\$5,540	1,470	\$1,870	7,050	\$10,800
Canada	38,700	40,900	20,100	18,900	33,100	43,900	19,900	25,200
China	156,000	146,000	122,000	136,000	136,000	94,800	155,000	92,600
Germany	6,500	9,150	14,200	16,800	9,480	8,030	16,400	19,600
Hong Kong	4,300	11,000	7,180	17,100	5,440	4,650	6,140	3,810
India	2,770	2,300	3,920	3,920	33,400	25,500	43,500	34,800
Japan	13,800	20,400	11,000	15,900	13,200	19,200	9,120	14,500
Korea, Republic of	24,400	37,400	14,900	21,100	17,800	25,000	18,700	25,700
Mexico	2,760	7,960	2,280	5,260	4,370	3,550	248	555
Taiwan	9,120	12,300	10,100	13,200	5,870	8,320	9,060	13,000
Other	2,290	3,130	4,840	4,740	11,700	9,250	12,500	9,910
Total	262,000	294,000	213,000	258,000	272,000	244,000	298,000	250,000

¹Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

			C	opper-alloy scrap)
	Unalloyed c	opper scrap		Copper	
	Quantity	Value ²	Gross weight	content ^{e, 3}	Value ²
Country or Territory	(metric tons)	(thousands)	(metric tons)	(metric tons)	(thousands)
2001	30,300	\$41,700	84,400	60,800	\$102,000
2002:					
Canada	13,900	22,200	38,700	27,900	50,300
Chile	611	916	78	56	99
Costa Rica	1,100	973	458	330	485
Dominican Republic	1,360	1,260	884	636	603
Germany	118	19	1,110	795	2,870
Guatemala	536	532	1,190	853	1,520
Honduras	399	518	347	250	946
Italy	116	679			
Jamaica	362	413	239	172	141
Japan	97	844	193	139	133
Mexico	9,250	8,830	18,300	13,200	18,500
Nicaragua	321	428	170	122	202
Panama	173	155	792	571	884
Philippines			96	69	1,260
United Kingdom	155	451	1,760	1,270	2,850
Venezuela	93	110	2,090	1,500	1,710
Other	647	680	4,440	3,200	6,280
Total	29,300	39,000	70,900	51,000	88,800

TABLE 19 U.S. IMPORTS FOR CONSUMPTION OF COPPER SCRAP, BY COUNTRY $^{\rm 1}$

^eEstimated. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Cost, insurance, and freight value at U.S. port.
³Content is estimated by the U.S. Geological Survey to be 72% of gross weight.

TABLE 20 COPPER: WORLD MINE PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons)

Country	1998	1999	2000	2001	2002 ^e
Albania ^e	3,200	900			2002
Argentina	170,273	210,126	145,197	191,677 ^r	204,027 3
Armenia	9,158 ^r	9,830 r	12,234 ^r	12,400 ^{r, e}	12,800
Australia:	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,	12,100	12,000
Concentrates	552,000	655,900	751,300	782,100	787,000 ³
Leaching, electrowon	55,000	83,100	77,700	86,900	96,000
Total	607,000	739,000	829,000	869,000	883,000
Bolivia	48	252	110 r	18 ^{r, e}	
Botswana ⁴	25,043	20,960 r	20,977 r	17,057 r	19,700
Brazil	34,446	31,371	31,786	30,111 ^r	30,100
Bulgaria	88,000	96,000 r	92,000 r	88,000 r	96,000
Burma:		,	. ,		,
Concentrates		97	100 ^e	e	
Leaching, electrowon	6,700 ^e	26,736	26,711	26,300 e	28,000
Total	6,700 °	26,833	26,811	26,300 e	28,000
Canada:		,	,	,	,
Concentrates	703,966	620,085	633,855	633,531 ^r	600,187 ³
Leaching, electrowon	1,800				
Total	705,766	620,085	633,855	633,531 ^r	600,187 ³
Chile: ⁵			,		,,
Concentrates	2,578,800	3,029,100	3,229,800	3,200,800	2,979,000 3
Leaching, electrowon	1,108,000	1,362,100	1,372,600	1,538,200	1,602,000 3
Total	3,686,800	4,391,200	4,602,400	4,739,000	4,581,000 3
China: ^e		.,	.,,	.,,,	.,,
Concentrates	486,000	520,000	593,000	587,000 ^r	560,000
Leaching, electrowon	18,000	13,000	20,000	18,000	25,000
Total	504,000	533,000	613,000	605,000 r	585,000
Colombia	1,400 °	2,295	2,062	2,000 e	2,000
Congo (Kinshasa), leaching, electrowon ⁶	34,994	32,000 °	21,000 °	20,988	29,000
Cuba	1,351	1,090	1,346	1,000 °	1,000
Cyprus, leaching, electrowon	4,936 ^r	5,004 r	5,200 r, e	5,200 r, e	5,200
Ecuador ^e	100	100	100	100	100
Finland ^e	9,000	10,500	14,354 ^r	13,715 ^r	14,400 ³
Georgia ^e	6,000	7,000	8,000	8,000	8,000
Honduras	(7)	(7)	e	e	
India	39,900	34,100 e	31,900	32,400 r	34,100 ³
Indonesia ⁶	780,780	766,027	1,012,054	1,081,040 r	1,160,000
Iran: ^e		·			
Concentrates	128,300 r, 3	131,000 r	125,000 r	121,000 r	121,000
Leaching, electrowon	10,000	10,000	10,000	12,000	12,000
Total	138,300 r, 3	141,000 ^r	135,000 r	133,000 r	133,000
Japan	1,070	1,038	1,211	744	750
Kazakhstan	337,600	374,000 e	430,000 °	470,100	490,000
Korea, North ^e	14,000	14,000	13,000	13,000	13,000
Korea, Republic of	41				
Macedonia	9,100	10,200	10,000 e	10,000 e	10,000
Malaysia	13,907	4,600			
Mexico:	· · · · ·	, ,			
Concentrates	335,822	330,232	308,966 r	310,623 r	260,574 ³
Leaching, electrowon	48,819	50,952	55,600 r	60,500 ^r	69,000
Total	384,641	381,184	364,566	371,123 ^r	329,574 ³
Mongolia	125,400	126,700	125,227	133,503	131,705 ³
Morocco	8,200	7,747 r	7,080 r	5,800 r	5,500
Namibia	7,500		5,620	12,392	18,012 ³
	,				
Norway ^e	$2,698^{-3}$				
Norway ^e Papua New Guinea	2,698 ³ 152,200	 187,921	200,900	218,000 e	211,311 3
				218,000 °	211,311 3
Papua New Guinea Peru:	152,200	187,921	200,900		,
Papua New Guinea				218,000 ° 590,896 131,139	211,311 ³ 686,748 ³ 156,465 ³

TABLE 20--Continued COPPER: WORLD MINE PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons)

Country	1998	1999	2000	2001	2002 ^e
Philippines	45,400	34,600	30,644	20,322	18,364 ³
Poland	435,800 r	463,200 r	454,100 r	474,000	502,800 ³
Portugal	114,637	99,500 °	76,200	82,900	77,000
Romania ⁸	19,065	16,807 ^r	16,079	19,185 ^r	20,000
Russia ^e		530,000	570,000	600,000 ^r	695,000
Saudi Arabia	782	821	900 ^e	800 ^e	800
Serbia and Montenegro ^e	70,900	51,700 ³	41,000	22,000	23,000
Slovakia ^e	155	124			
South Africa	166,000	144,263	137,092	141,865	129,589 ³
Spain	37,000	1,738	23,312	9,700	5,000
Sweden	73,685	71,200	77,765 ^r	74,269 ^r	72,100 ³
Tanzania, in concentrates and bullion				2,645 r	3,900
Turkey ⁸	40,000 ^e	73,051	76,253	69,000 ^{r, e}	60,000
United States: ⁶					
Concentrates	1,250,000	1,010,000	887,000	714,000	601,000 ³
Leaching, electrowon	609,000	586,000	557,000	624,000 ^r	542,000 ³
Total	1,860,000	1,600,000	1,440,000	1,340,000	1,140,000 3
Uzbekistan ^e	65,000 ³	60,000	65,000	65,000	65,000
Zambia:					
Concentrates	258,000	213,000	184,100 ^r	233,000 ^r	251,100 ³
Leaching, electrowon	57,000	67,000 ^r	65,000 ^r	79,000 ^r	78,900 ³
Total	315,000 9	280,000 r, 9	249,100 r	312,000 ^r	330,000 ³
Zimbabwe:					
Concentrates		3,491	2,104	2,057	2,502 3
Leaching, electrowon ^e	2,400	1,020 3			3
Total	6,000 °	4,511	2,104	2,057	2,502 3
Grand total	12,100,000	12,800,000 r	13,200,000	13,700,000	13,600,000
Of which:					
Concentrates	10,100,000	10,400,000	10,900,000	11,100,000	11,000,000
Leaching	2,060,000	2,350,000	2,340,000	2,600,000	2,640,000

^eEstimated. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table represent copper content by analysis of concentrates produced (includes cement copper, if applicable), except where otherwise noted. Table includes data available through July 22, 2003.

³Reported figure.

⁴Copper content of pelletized nickel-copper matte produced in smelter.

⁵Reported by Comision Chilena del Cobre. Includes recoverable copper content of nonduplicative mine and metal products produced from domestic ores and concentrates and leach production for electrowinning.

⁶Recoverable content.

⁷Less than 1/2 unit.

⁸Excludes copper content of pyrite.

⁹Data are for fiscal years beginning April 1 of year stated.

TABLE 21 COPPER: WORLD SMELTER PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons, gross weight)

Country	1998	1999	2000	2001	2002 ^e
Albania, primary	1,632	1,281		e	
Australia, primary	211,000	332,000	394,000	455,000	458,000
Austria, secondary	54,800 °	77,573	70,000 °	68,642 ^r	65,000
Belgium:					
Primary	r	^r	r	r	
Secondary	138,400	143,300	144,700	138,200	126,000
Total	138,400 ^r	143,300 ^r	144,700 ^r	138,200 ^r	126,000
Botswana, primary ³	22,124	20,960	20,977	17,057	19,700
Brazil, primary	167,205	193,014	185,345	204,300 r	174,000
Bulgaria:			· • • • •		
Primary	114,500	107,000	173,000 r	152,000 r	150,000
Secondary ^e	5,000	5,000	5,000	5,000	5,000
Total	119,500	112,000 ^e	178,000 ^r	157,000 ^r	155,000
Canada:			543 (00)	(01.400.F	512 000 /
Primary	553,133 r	550,200	543,600	601,400 r	513,900
Secondary	71,338 r	66,800	60,100	41,600 r	24,800
Total	624,471 r	617,000	603,700	643,000 ^r	538,700
Chile, primary	1,403,100	1,473,900 r	1,460,400	1,503,300	1,439,000 4
China: ^e			1 000 000	1 100 000	1.0.000
Primary	839,000	837,000	1,020,000	1,120,000	1,240,000
Secondary		190,000	180,000	190,000	250,000
Total	1,009,000	1,027,000	1,200,000	1,310,000	1,490,000
Congo (Kinshasa), primary, electrowon ^e	40,000	32,000	21,000	20,988 4	29,000
Finland:		140,000	155 400	1(0,200	1.00.000 4
Primary		149,600	155,400	169,300	160,900
Secondary ^e	<u>2,000</u>	2,000	2,000	2,000	2,000
Total		151,600	157,400	171,300	162,900
France, secondary ^e	2,000	1,000			
Germany:		266 400	275 000 ¢	270 000 e	212 000
Primary	258,600	266,400	275,000 °	270,000 °	312,000
<u>Secondary</u> ^e	80,000	60,000	75,000	60,000	60,000
Total	338,600	326,400	350,000 °	330,000 °	372,000
India, primary	107,600	224,400	256,000 °	293,000 °	380,000
Indonesia, undifferentiated		126,739	173,726	217,500	211,200 4
Iran, undifferentiated ^{e, 5}	138,000 r	132,000 ^r	135,000 ^r	135,000 ^r	146,000
Japan:		1,256,276	1 221 252	1 229 490	1 217 201 4
Primary Secondary	1,171,657 131,979		1,331,352 149,282	1,328,489 139,764	1,317,291 ⁴ 182,069 ⁴
Secondary Total	1,303,636	133,188 1,389,464	1,480,634	1,468,253	1,499,360 4
Kazakhstan, undifferentiated			413,859	433,600 r	446,200
· · · · · · · · · · · · · · · · · · ·		383,457 14,000	,	13,000	13,000
Korea, North, primary and secondary ^e Korea, Republic of, undifferentiated	293,000	370,000	13,000 410,000 °	410,000 °	410,000
	293,000	370,000	410,000	410,000	410,000
Mexico: Primary		322,000 ^r	312,000 r	310,000 ^r	271,000
	4,000	5,000	5,000	5,000	5,000
Secondary ^e Total		327,000 r	317,000 r	315,000 r	276,000
		527,000 ^e	5,082	27,015	278,000 17,850 ²
Namibia, primary ⁸ Norway, primary	0,014	r	5,082	27,015	17,850
	24,400	16,818	23,790	24,200 r	24,000
Oman, primary Peru, primary	24,400 357,100 r	363,100 ^r	366,700 ^r	396,400 ^r	370,300
			,		
Philippines, primary Poland:	161,600	162,000	160,000	165,000 ^r	165,800 4
	432,200 r	466 200 r	462,800 r	485 000 r	186 000
Primary	432,200 ^r	466,200 ^r 27,300 ^r	462,800 ^r 19,700 ^r	485,900 ^r 27,900 ^r	486,000 29,000
Secondary ^e Total		493,500 r	482,500 r	27,900 ^r	/
	451,500 r	493,300	402,300	515,000	515,000
Romania:	10 700	24 010 r	16 420 r	0 270 r	10.000
Primary		24,010 ^r	16,429 ^r	9,279 ^r	10,000
Secondary ^e	1,000	2,000	2,000	2,000	2,000
Total See footnotes at end of table.	19,708	26,010 r	18,429 r	11,279 ^r	12,000

See footnotes at end of table.

TABLE 21--Continued COPPER: WORLD SMELTER PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons, gross weight)

Country	1998	1999	2000	2001	2002 ^e
Russia: ^e					
Primary	520,000 r	580,000 r	600,000 ^r	650,000 ^r	660,000
Secondary	80,000 r	158,000	220,000	245,000 r	200,000
Total	600,000 ^r	738,000 ^r	820,000 r	895,000 ^r	860,000
Serbia and Montenegro: ^e					
Primary	101,000	54,000	45,000	34,000	36,000
Secondary	10,000	49,780 4	45,000	35,000	30,000
Total	111,000	103,780 4	90,000 ⁴	69,000	66,000
Slovakia, primary ^e	10,000	10,000			
South Africa, primary	152,300	149,300	136,100 ^r	142,500	98,000
Spain:					
Primary	291,400	292,800	258,600 r	255,200 r	281,000
Secondary	23,800	25,000 °	31,300 ^r	24,700	16,700
Total	315,200	317,800	289,900 r	279,900 r	298,000 4
Sweden: ^e					
Primary	90,000	85,000	95,000	173,000	188,000
Secondary	35,000	30,000	35,000	35,000	35,000
Total	125,000	115,000	130,000	208,000	223,000
Turkey, undifferentiated ⁶	32,900 ^r	32,900	32,500	33,500 ^r	30,000
United States:					
Primary	1,490,000	1,090,000	W	W	W
Secondary	232,000	205,000	W	W	W
Total	1,720,000	1,290,000	1,000,000	919,000	683,000 4
Uzbekistan: ^e					
Primary	89,930 ³	72,000	75,000	75,000 ^r	75,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	94,930 ³	77,000	80,000	80,000 r	80,000
Zambia, primary: ⁷					
Electrowon	51,736	60,200	50,000	50,000 ^e	60,000
Other	206,871	289,000	308,300	306,000 r	311,400 4
Total	258,607	349,200	358,300	356,000 r	371,400 4
Zimbabwe, primary: ^{e, 8}	14,500	14,500	14,500	2,160	2,502 4
Grand total:	11,300,000 r	11,700,000 r	11,000,000 r	11,500,000 r	11,500,000
Of which					
Primary:					
Electrowon	91,700	92,200	71,000	71,000	89,000
Other	9,350,000 r	9,400,000 r	8,690,000 r	9,170,000 r	9,160,000
Secondary	1,070,000 r	1,190,000 ^r	1,050,000 ^r	1,020,000 r	1,040,000
	829,000 r	1,060,000 r	1,180,000 ^{r, 9}	1,240,000 r, 9	1,260,000

^eEstimated. ^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²This table includes total production of smelted copper metal, including low-grade cathode produced by electrowinning methods. The smelter feed maybe derived from ore, concentrates, copper precipitate or matte (primary), and/or scrap (secondary). To the extent possible, primary and secondary output of each country is shown separately. In some cases, total smelter production is officially reported, but the distribution between primary and secondary has been estimated. Table includes data available through July 22, 2003.

³Copper content of nickel-copper matte exported to Norway for refining.

⁴Reported figure.

⁵Data are for year beginning March 21 of that stated. Secondary production is estimated to be about 5% of total.

⁶Secondary production is estimated to be about one-third of total.

⁷For 1998 and 1999, fiscal year beginning April 1 of year stated. Electrowon is total electrowon production reported less the quantity reported as "finished production, leach cathodes."

⁸Includes impure cathodes produced by electrowinning in nickel processing.

⁹Includes U.S. production undifferentiated.

TABLE 22 COPPER: WORLD REFINERY PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons)

Country	1998	1999	2000	2001	2002 ^e
Albania, primary	1,150	342	r	r	
Argentina, secondary ^e	16,000	16,000	16,000	16,000	16,000
Australia:					
Electrowon	55,000	84,000	97,000 °	102,000 e	96,000
Primary	230,000	335,000	390,000 ^e	456,000 ^e	449,000
Total	285,000 r	419,000 r	487,000 ^e	558,000 ^e	545,000
Austria: ^e					
Primary	2,000	2,000	2,000		
Secondary	76,000	75,000	77,000	69,000	65,000
Total	78,000	77,000	79,000 ³	69,000	65,000
Belgium: ⁴					
Primary	185,000	201,100	236,100	236,000 e	207,000
Secondary ^e	183,000 ³	187,000	187,000	187,000	216,000
Total	368,000	388,100	423,100	423,000	423,000
Brazil, primary	167,205 r	193,014	185,345	212,243 ^r	187,700 ³
Bulgaria:		,	· · · · · · · · · · · · · · · · · · ·		,
Primary	31,400	16,000 ^e	27,500 ^{r, e}	29,400 ^r	30,000
Secondary ^e	5,000	5,000	5,000	5,000	5,000
Total	36,400	21,000	32,500 r	34,500 r	35,000
Burma, electrowon	6,700 °	26,736	26,711	26,300 °	28,000
Canada:		20,700	20,711	20,000	20,000
Electrowon	1,800		e	e	
Primary	489,941 r	476,079 ^r	490,093 ^r	524,920 ^r	468,503 ^p
Secondary	72,635 ^r	72,484 ^r	61,300	42,800 r	25,770 ^p
Total		548,563 r	551,393 ^r	567,720 r	494,273 ^p
Chile:		548,505	551,595	507,720	494,275
Electrowon	1,108,000	1,362,100	1,372,600	1,538,200 ^r	1,602,000 3
Primary	1,226,900	1,304,300	1,295,700	1,344,000	1,002,000 $1,248,100^{-3}$
Total	2,334,900	2,666,400	2,668,300	2,882,200 r	2,850,100 3
	2,554,900	2,000,400	2,008,500	2,882,200	2,830,100
China: ^e Electrowon	18,000	12 000	20.800	18 000	20,000
	852,000 r	13,000 823,000 r	20,800	18,000	,
Primary	/	,	1,003,000 ^{r, 3}	1,200,000 r	1,280,000
Secondary	341,000	338,000	347,000	300,000 r	350,000
Total	1,210,000	1,170,000	1,370,000	1,520,000 r	1,650,000
Congo (Kinshasa), primary ⁵	38,236	31,225	20,500 °	21,000 °	10,000
Cyprus, electrowon	4,936	5,004	5,197	5,176	3,631 ^p
Egypt, secondary ^e	6,000	6,000	5,000	5,000	5,000
Finland. ^e		100.000	100.000	105 000 r	100.000
Primary	108,000	100,000	100,000	105,000 r	100,000
Secondary	15,000	15,000	14,000	15,000	15,000
Total	123,000	115,000	114,000	120,000 r	115,000
France, secondary ^e	22,400	1,800	1,500		
Germany: ^e					
Primary	275,000 r	242,000 r	245,000 r	352,000 r	330,900 ³
Secondary	421,000 r	454,000 r	465,000 r	342,000 r	364,900 3
Total	696,000 r	696,000	710,000	694,000 ^r	695,800 ³
Hungary, secondary ^e	12,000	12,000	12,000	10,000	10,000
India:					
Primary, electrolytic	100,000	200,000 ^e	234,000 ^e	310,000	354,000
Secondary ^e	7,000	8,000	9,000	18,000	20,000
Total ^e	107,000	208,000	243,000	328,000	374,000
Indonesia, primary		90,800	158,400	212,500	192,400 ³
Iran: ⁶					
Electrowon ^e	9,500 ^{r, 3}	10,000 ^r	10,000 r	12,000 r	12,000
Primary ⁷	129,000	131,700	132,000 ^e	132,000 ^e	143,000
Total	138,500 r	141,700 ^r	142,000 r	144,000 r	155,000
Italy, secondary	29,100 ^e	28,500 e	72,800	35,500	29,000
Japan:					
Japan.					
Primary	1,149,266	1,215,248	1,292,351 r	1,287,165 r	1,211,111
	1,149,266 128,086	1,215,248 126,301	1,292,351 ^r 149,260 ^r	1,287,165 ^r 138,526 ^r	$ \begin{array}{r} 1,211,111 & {}^{3} \\ 189,968 & {}^{3} \\ \hline 1,401,079 & {}^{3} \end{array} $

See footnotes at end of table.

TABLE 22--Continued COPPER: WORLD REFINERY PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons)

Country	1998	1999	2000	2001	2002 ^e
Kazakhstan, primary	324,900	361,889	394,722	425,700 r	453,000 ³
Korea, North, primary and secondary ^e	16,000 r	16,000	14,000 ^r	14,000 ^r	14,000
Korea, Republic of, primary	373,205	450,444	467,900	473,624	500,000
Mexico:					
Primary:					
Electrowon	48,819	50,952	55,600 r	59,800 r	69,100
Other	383,181	361,000	340,400	349,000 ^r	319,000
Secondary ^e	15,000	14,000	15,000	15,000	35,000
Total	447,000	425,952	411,000 r	423,800 r	423,100
Mongolia, electrowon	2,319	1,545	641	1,476	1,500 ³
Norway, primary	31,658	33,262	27,000 °	26,700	30,500
Oman, primary	22,700	17,171	24,281	24,000 r, e	24,000
Peru, primary:					
Electrowon	101,837	114,425 ^r	127,311	131,139	156,465 ^p
Other	309,594	318,914	324,417	340,736	346,277 ^p
Total	411,431	433,339 ^r	451,728	471,875	502,742 ^p
Philippines, primary	152,400	147,982	150,000 ^r	164,530	144,315 ³
Poland:					
Primary	426,537	448,300	498,100 ^r	498,451 ^r	508,674 ³
Secondary ^e	20,300 °	22,200	19,700 ^r	30,286 ^r	19,146 ³
Total	446,837	470,500	517,800 r	528,737 ^r	527,820 ³
Romania:					
Primary	21,028	24,983	13,803	18,500 ^r	21,000
Secondary ^e	2,000	4,000	4,000	4,000	4,000
Total	23,028	28,983	17,803	22,500 r	25,000
Russia:					
Primary	543,000	600,000	620,000 r	650,000	670,000
Secondary	77,000	160,000 r	220,000 r	244,500	200,000
Total	620,000	760,000 ^r	840,000 ^e	894,500	870,000
Serbia and Montenegro:					
Primary	49,346	48,002	45,602	32,365	35,897 ³
Secondary ^e	45,000	1,900	40,000	30,000	17,000
Total	94,346	49,902	85,602	62,365	52,897 ³
Slovakia, primary ^{e, 7}	24,100	21,000	r	r	
South Africa, primary ⁷	125,600	134,500	126,100	107,000 ^r	101,000
Spain:					
Primary	239,600	250,756	258,000	235,100	272,000
Secondary ^e	64,730 ³	65,000	58,000	55,600 ³	37,000
Total	304,330 r	315,756 ^r	316,000 °	290,700	309,000 ³
Sweden: ^e					
Primary	100,000	95,000	105,000	179,000 ³	199,000
Secondary	25,000	20,000	25,000	25,000	25,000
Total	125,000	115,000	130,000	204,000 ³	224,000
Taiwan, secondary ^e	4,000	4,000	4,000	4,000	4,000
Turkey: ^e					
Primary	82,800 ³	55,500 r	59,100 r	54,400 r	39,000
Secondary	9,000 ³	5,000 ^r	5,000 ^r	4,000 ^r	2,000
Total	91,800 3	60,500 ^r	64,100 ^r	58,400 r	41,000
United Kingdom:					
Primary	8,000	5,000 °		e	
Secondary	44,000	45,000 ^e	3	e	
Total	52,000	50,000 °	3	^e	
United States:		,			
Primary:					
Electrowon		586,000	566,000 r	628,000	601,000
Other	1,530,000	1,300,000	1,030,000	1,000,000	841,000
Secondary	349,000	230,000	208,000	172,000	70,000
Total	2,490,000	2,120,000	1,800,000 r	1,800,000	1,510,000
See footnotes at end of table	2,770,000	2,120,000	1,000,000	1,000,000	1,510,000

See footnotes at end of table.

TABLE 22--Continued COPPER: WORLD REFINERY PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

Country	1998	1999	2000	2001	2002 ^e
Uzbekistan: ^e					
Primary	89,930 ³	72,000	75,000	75,000	75,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	94,930 ³	77,000	80,000	80,000	80,000
Zambia, primary:					
Electrowon	80,709	60,200	50,000	79,000 ^r	83,700 3
Other	248,820	258,900	227,400	217,500 r	$253,100^{-3}$
Total	329,529 8	319,100 8	277,400	296,500 r	336,800 3
Zimbabwe:					
Electrowon ^e	2,400	1,020			3,000
Primary	2,940	7,000	7,200 ^e	5,300 °	3,000
Total	5,340	8,020	7,200 °	5,300 °	6,000
Grand total:	14,100,000	14,600,000	15,000,000 r	15,700,000 r	15,500,000
Of which:					
Primary:					
Electrowon	2,050,000 r	2,310,000	2,330,000 r	2,600,000 r	2,680,000
Other	10,100,000 ^r	10,400,000 ^r	1,060,000 ^r	11,300,000 ^r	11,100,000
Secondary	1,990,000 ^r	1,920,000 r	2,030,000 r	1,770,000 r	1,730,000

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²This table includes total production of refined copper whether produced by pyrometallurgical or electrolytic refining methods and whether derived from primary unrefined copper or from scrap. Copper cathode derived from electrowinning processing is also included. Table includes data available through July 22, 2003.

³Reported figure.

⁴Includes reprocessed leach cathode from Congo (Kinshasa).

⁵Excludes leach cathode exported for processing in Belgium.

⁶Data are for Iranian years beginning March 21 of that stated.

⁷May include secondary.

⁸Data are for fiscal year beginning April 1 of that stated. Electrowon covers only high-grade electrowon cathodes reported as "finished production leach cathodes."