TIN

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In 1997, there was no domestic mine production of tin. Of the primary tin used domestically, 25 firms consumed about 85%. The major uses were as follows: cans and containers, 25%; electrical, 20%; transportation, 12%; construction, 10%; and other, 33%. The estimated value of primary metal consumed domestically was about $300 million.

About 12,300 metric tons of tin in purchased old and new tin scrap, including tin alloys, was recycled. Of this, about 7,830 tons was old scrap. About one-fourth of the tin consumed in the United States was produced at 7 detinning plants and 110 secondary nonferrous metal processing plants. Interest continued in the recycling of used tin cans, largely owing to the rising costs and limited space of landfills. The recycling rate for steel cans was 60% in 1997, having risen from 58% in 1996, 56% in 1995, 53% in 1994, 40% in 1993, and 15% in 1988. By yearend, 11,722 tons of pig tin had been sold from the National Defense Stockpile (NDS), leaving 100,609 tons in inventory.

World tin mine output increased slightly. Industry observers believed that world supply and demand were in approximate equilibrium. The average Platt's Metals Week composite price of tin declined by 8%.

Tin was mined in 24 countries, the top 5 of which accounted for about 82% of the world total of 211,000 tons. China was the largest producer (31% of the world total) and was followed by Indonesia (22%), Peru (13%), Brazil (9%), and Bolivia (7%).

World tin reserves, estimated to be 8 million metric tons, were considered to be adequate to meet the world's future tin requirements. Assuming that the world primary tin consumption will be about 200,000 tons per year, these reserves would last 38 years. Most tin reserves were in Asia and South America.

Legislation and Government Programs

The NDS continued in its eighth year of being managed by the U.S. Department of Defense, with day-to-day operations being guided by the Defense Logistics Agency (DLA). In 1997, the DLA sold 11,722 tons of pig tin from the stockpile. Of this total, 10,142 tons represented a long-term sales contract to RMT Corp. and Considar Inc. (both of New York, NY). The DLA continued its monthly spot tin sales program under the same format as in the latter part of 1996, with sales being held on the first Wednesday.

The following depots held the largest inventories of tin, in descending order: Hammond, IN, Anniston, AL, Point Pleasant, WV, and Stockton, CA. At yearend, 100,609 tons of tin remained in the NDS.

Production

Mine Production.—For the fourth consecutive year, tin was not produced at any domestic mine. Before 1994, one or two small tin mines had operated for many years. Domestic mine production data for tin were developed by the U.S. Geological Survey from a voluntary survey of mines. The five firms to which a survey form was sent all responded.

Secondary Production.—The United States is believed by industry observers to be the world's largest producer of secondary tin. Tin metal recovered from new tinplate scrap and used tin cans was the only type of secondary tin available in the marketplace as free tin; most secondary tin was produced from the various scrapped alloys of tin and recycled in those same alloy industries. Secondary tin from recycled fabricated parts was used in many kinds of products and was a major source of material, particularly for the solder and the brass and bronze industries.

The former Steel Can Recycling Institute, which had been started in 1988 and funded by five domestic tinplate producers to advance the collection, preparation, and transportation of steel can scrap, was in its fourth full year of expanded activities under its new name, the Steel Recycling Institute (SRI). The SRI fostered the collection of all steel scrap (ranging from appliances to cars), not just steel cans. The SRI continued to maintain its program of having representatives in various regions of the United States work with municipalities, scrap dealers, and detinners to promote the recycling of tin cans. The SRI announced that the recycling rate for steel cans reached a new high of 60% in 1997. In the 9 years of SRI's existence, the recycling rate for steel cans has quadrupled—from 15% in 1988 to 60% in 1997. The SRI continued to place special emphasis on the recycling of aerosol steel cans.

More than 1.7 million tons of scrap steel cans was collected by the estimated 200 million Americans who have access to steel can recycling from curbside, drop-off, and buy-back programs. In 1996, steel mills that operated electric arc furnaces, often called minimills, directly consumed a record 522,000 tons of scrap cans, or 32% of the total generated. Integrated steel mills, which generally use basic oxygen furnaces and make the tinplate feedstock for tin cans, consumed 424,000 tons of scrap cans. Detinners processed 136,000 tons of scrap cans, and iron foundries used 42,000 tons of scrap cans. The export market absorbed 56,000 tons of used steel cans. Other uses accounted for 460,000 tons (Container Recycling Report, 1997a).

Following the completion of its purchase of Proler International Corp. (Houston, TX) early in the year, Schnitzer Steel Industries, Inc. (Portland, OR) closed the two former Proler detinning plants in Coolidge, AZ, and Seattle, WA. Schnitzer continued to operate the former Proler scrap plant in Lathrop, CA, which processes tinplate scrap and scrapped tin cans (Container Recycling Report, 1997b).

AMG Resources Corp. announced that it is upgrading its can detinning plants at Gary, IN, and Pittsburgh, PA, to handle steel cans better. At each plant, a 6,000-ton-per-month machine has been installed that debales cans, trommels the load to reduce contaminants, shreds the metal, and further separates the steel from the nonmetallic materials. The firm plans to install a similar unit at its Baltimore, MD, detinning plant (Container Recycling Report,

1997c).

Consumption

In 1997, domestic consumption of primary tin decreased by about 1% and consumption of secondary tin rose by about 1. Domestic consumption data for tin were developed by the U.S. Geological Survey from a voluntary survey of tin consumers. Of the 214 firms to which a survey form was sent, 193 responded, for a 93% response rate.

Aluminum accounted for 76% of the 137 billion metal cans shipped domestically; tinplated steel and tin-free steel accounted for 24%. These percentages were the same as those of 1996, when 135 billion cans were shipped domestically. Aluminum held 100% of the beverage can market, and steel dominated in the food can and the "general-line" can markets (Can Manufacturers Institute, 1997).

Wheeling-Pittsburgh Steel Corp. (Wheeling, WV), a major domestic tinplate producer, experienced a protracted strike by the United Steelworkers Union. The strike, which began on October 1, 1996, and ended in August 1997, centered on economic issues related to pension benefits. The dispute was settled in early August when the union approved a 5-year labor pact that expires on September 1, 2002. The strike was one of the longest domestic steel strikes on record. Wheeling ranks as an important domestic tin user (American Metal Market, 1997f).

USS-Posco Industries (Pittsburgh, CA), a major domestic tinplate producer, was considering a $100 million upgrade of its tin mill. The operation is a joint venture of U.S. Steel Group and Pohang Iron and Steel Ltd., of the Republic of Korea, and is the only tin mill on the West Coast. If approved, the project would begin in 1998 and be completed by 1999. One major change reportedly would be to enable the 2,200-foot-per-minute tinplate and tin-free-steel line to produce tinplate products up to 48 inches wide. Only a few tin mills in the world have this capability; the maximum capability in the United States is 42 inches, with many products restricted to 37 inches. Some tinplate buyers were reportedly planning to install large end-presses that would be compatible with tinplate coils from a wider USS-Posco tinplate line. USS-Posco's tinplate production was estimated to be 450,000 tons per year, more than one-half of the estimated 750,000- to 800,000-ton-per-year West Coast tinplate market (CRU International, 1997f).

General Motors (GM) Corp. (Detroit, MI) announced it would no longer use terne plate in the fuel tanks of its standard-size pickup trucks after summer 1998. The automaker indicated that it would use plastic tanks instead to accommodate alternate fuels better and to help achieve a weight reduction. Terne plate is a flat-rolled steel product having a 92% lead-8% tin coating on each side. This switch by GM is believed to be the single largest withdrawal from any single application in the auto market. The domestic and world markets for automobile fuel tanks have shown a mixed pattern in recent years. Domestically, Chrysler Corp. has converted completely to plastic; Ford Motor Corp. uses a mix of plastic and terne plate; and GM uses a mix also but is believed to be the largest user of terne plate for fuel tanks in North America. One analyst believed the current breakdown for the North American automobile fuel tank field was 60% terne plate and 40% plastic. Europe reportedly is strong in plastic tanks, possibly 80% of the market. Asia appears to favor a lead-nickel terne plate. Domestic terne plate producers include AK Steel Corp. (Middletown, OH), U.S. Steel Corp. (Pittsburgh, PA), and WCI Steel Inc. (Warren, OH) (American Metal Market, 1997c).

Prices

The Platt's Metals Week composite price for tin metal generally drifted lower during 1997. The average monthly composite price reached its peak for the year in January and reached its nadir in August. The 1997 average annual composite price was 8% lower than that for 1996.

The London Metal Exchange (LME) remained the primary trading arena for tin. Tin was one of only six metals(along with aluminum, copper, lead, nickel, and zinc) to be traded on the LME. The Kuala Lumpur Commodities Exchange in Malaysia continued as an active tin-trading forum.

Foreign Trade

Imports, which supply most domestic requirements, increased by about 34% in 1997. Imports of tin in all forms (ore and concentrate, metal, waste, and scrap) remained duty free. (*See tables 7, 8, and 9.*) In the United States, trading firms marketed most of the tin metal, which they imported from a variety of countries and warehoused in this country until they sold it to customers. Foreign-owned firms tend to dominate the field. Most tin dealers were based in the New York, NY, area. Some tin was also marketed directly in the United States by large foreign producers that maintained sales offices here and sold their tin metal, usually on a 1-year contract basis, only to the largest users. Perhaps foremost among these direct-sale operations was Indo-Metal Corp., which served as the exclusive North American sales outlet for tin metal produced by Indonesia's largest tin producer, P.T. Tambang Timah.

For the sixth consecutive year, Brazil was the largest source of U.S. tin metal imports. Indonesia ranked second and was followed by Bolivia and Peru.

World Review

Australia.—Norminco halted production at its Leichardt Creek Mine in northern Queensland amid reports of financial difficulties. The mine had been operating at low levels owing to falling ore grades. On January 16, 1997, Norminco's shares were suspended from trading on the Sydney Stock Exchange, and the firm entered into receivership. Reportedly, Norminco was negotiating with Macquarie Bank, which set up the finance package to facilitate the firm's original $2 million investment program when the mine started in 1995 (CRU International, 1997b).

Belgium.—Metallo-Chimique announced that it was raising production of LME-grade tin at its Beerse plant to 9,000 tons per year in 1997, from 6,000 tons per year in 1996. The firm, which also has U.S. scrap operations, has long been an important secondary copper, lead, and tin producer. Its secondary tin production has been mostly a byproduct of copper scrap processing but now increasingly comes from tin scrap (Metal Bulletin, 1997c).

Bolivia.—The planned sale of the Bolivian Government's tin properties has been beset by problems and delays since the idea was conceived in 1995. The properties include the Vinto tin smelter and its associated Colquiri and Huanuni tin mines, all owned by Corporación Minera de Bolivia. The Government wished to semi-privatize all three properties by selling a 50% interest in them to

private owners. Early in 1997, the Government prequalified three potential bidders, Glencore International, Renison Goldfields Consolidated, and Paranapanema. All three, however, reportedly failed to submit bids by the June deadline. Local sources speculated that the lack of bids may have been due to unresolved labor problems, an inadequate judicial framework for the auction, and a lack of information about Vinto. The auction winner would have had to match Vinto's book value of $37 million and settle its $25 million debt. The Vinto tin smelter had been up for sale to the private sector for more than a year but remained unsold, and with the continuing delays in the sale process, industry sources believed Vinto to be in a deteriorating financial condition. Vinto's position was aggravated by the fact that neighboring Peru would soon no longer require a tolling contract with Vinto as production capability at its Minsur tin smelter is augmented. Minsur ships from 5,000 to 8,000 tons per year of concentrates (50% tin) to Vinto. Minsur's own recently constructed tin smelter was expected to produce 12,000 tons of refined tin in 1997, with output possibly rising to 15,000 tons in 1998 (Platt's Metals Week, 1997e).

The Government-owned smelting organization, Empressa Nacional de Fundiciones, decided to hold an invited tender for its 1998 tin production from the Vinto tin smelter instead of continuing the current sales agreement with trading firm Toyota (400 tons per month). Bolivia, along with Indonesia and Peru, is an important supplier of low-lead tin, which has become a much desired item for tin mills during the past few years. Premiums for low-lead tin range from $200 to $225 per ton for 100 parts per million lead to $225 to $275 per ton for 50 parts per million lead (Ryan's Notes, 1997).

Pan American Silver Corp. (Canada) announced that it had uncovered a major new tin resource at the Maragua prospect in Bolivia. Reportedly, the prospect has a geology similar to that of the Cerro-Rico silver-tin mine at Potosi. Exploration was conducted in two separate zones, the Chipas and the Foster. The Chipas is a bulk-tonnage silver target at a small silver mine, and the Foster, about 3 miles away, is a large and intense alteration zone. A number of small tin workings are located in this area, which is the focus of the exploratory program. The second phase of the exploration program is expected to begin later this year (CRU International, 1997d).

Brazil.—Paranapanema, the country's largest tin producer, expected to produce 17,000 tons in 1997 and 21,000 tons in 1998. The company reportedly had increased its refined tin production to 15,000 tons in 1996 from 12,000 tons in 1995. Production, however, still lagged behind the levels of the early 1990's when output reached 27,000 tons per year. The dip in output was often attributed to a lack of sufficient investment. A higher level of investment reportedly resumed in 1996 after the company's merger with a State pension fund. (CRU International, 1997c).

Cia. Siderúrgica Nacional (CSN), the country's largest steel producer, announced a major thrust to win back part of the aluminum-dominated market for beverage cans. CSN will establish a $70 million canmaking plant in the northeastern city of Fortaleza, State of Ceará, to produce two-piece cans from tinplate. The plant, called Metalic, will have an initial capacity of 70,000 tons per year (about 700 million cans). Reportedly, all Metalic's initial production has been sold. The plant will be supplied with tinplate from CSN's Volta Redonda plant in the State of Rio de Janeiro. According to a CSN market study, metal can demand has grown at an average of 7% per year during the last 15 years. In 2000, metal cans will control an estimated 20% of Brazil's beverage market, the rest being glass and plastic bottles; that 20% share will represent 12 billion cans per year. In 1996, 4 billion aluminum beverage cans were used in Brazil. CSN feels that eventually tinplate will have substantial cost advantages over aluminum, especially because aluminum prices are much more dependent on electricity prices. CSN is the only Brazilian tinplate producer with output of more than 1 million tons per year. CSN has six electrolytic tinplating lines using the Ferrostan process (Metal Bulletin, 1997b).

Canada.—A feasibility study at ADEX Mining Inc's. (Mount Pleasant, New Brunswick) tin development indicates that resources at the site could total 3.6 million tons of ore grading 0.8% tin and 107 parts per million indium. ADEX estimated that resources could rise to about 8 million tons, a level that could be sufficient for an 8 - to 10-year mine life (Platt's Metals Week, 1997a).

China.—In a paper entitled "The Present Status of the Tin Industry in China" presented at the International Tin Research Institute (ITRI) World Tin Conference in May, an official of Yunnan Tin Corp. provided numbers that put a rare focus on usage patterns in China. Translated to tonnage terms, China's use of tin for solder was 3,100 tons in 1984 and 9,000 tons in 1996, and was predicted to be 13,000 tons in 2000 (ITRA Market Monitor, 1997b).

Quinghai's Xitiexhan Mining Department signed an agreement for a tin mining project that had been in discussion for 4 years. The project could cost an estimated $5 million, and take 3 years to complete. Capacity was expected to be about 450,000 tons per year of tin ore. The overall design will be overseen by the Lanzhou Nonferrous Metallurgy Research Center (CRU International, 1997a).

France.—Progress was reported on the proposed business deal that, will involve, in part, the merger of two large European canmakers—Pechiney (France) and Schmalback-Lubeca (Germany). A letter of intent had been signed in November 1996 with Doughty Hanson and Company, a private equity fund, giving each canmaker a 20% share of ownership. Estimated sales would be $1.4 billion per year from 35 plants in Europe and Japan. The deal is subject to Government and stockholder approval. The merger would create the second largest metal container firm in Europe. Carnaud Metalbox would remain the largest, with estimated annual sales of $2.2 billion (CRU International, 1997f).

Germany.—The tinplate production joint venture, Rasselstein Hoesche GmbH, reported output rising to 1.2 million tons in 1996 from 1.1 million tons in 1995. Rasselstein was formed from the merger of Thyssen Stahl AG (Duisburgh, Germany) with a 75% interest and Krupp Hoesch Stahl AG (Dortmund, Germany) with a 25% interest. Rasselstein claims to hold 20% of the European market for tinplate and to be the world's largest exporter of tinplate, exporting 400,000 tons from Europe in 1996 (American Metal Market, 1997b).

India.—Hamco Mining and Smelting Co. announced that it would be expanding its mine output and adding new smelting capacity in 1998, increasing its current tin output of about 6,000 tons per year by several thousand tons. Hamco officials announced that the firm was preparing to join the United Kingdom-based International Tin Research Institute during the coming year. The "HAMCO" brand of refined tin was approved for listing on the LME in 1997 (Platt's Metals Week, 1997b).

Malaysia.—For most of this century, this country has been the world's foremost tin producer. Tin mining in Malaysia, however, has declined markedly in the last decade. The decline was driven largely by lower tin prices, as well as the desire of the Government,

companies, and employees to move into some fast-growing areas of opportunity, such as light manufacturing, car production, electronics, and tourism. Some firms, such as Malaysia Mining Corp., have continued their mining activity and also have diversified into other metals and other countries. Only 42 tin-mining companies, including dredges and open cast mines, are registered in Malaysia. Rahman Hydraulic Tin, the oldest operating tin-mining firm in Malaysia, started in 1907, is now the country's largest tin miner (Tin International, 1997b).

Peru.—This country has now emerged as the dominant tin producing country in South America. In 1997, Minsur, the country's only tin producer, produced 28,000 tons of tin-in-concentrate, up from 27,000 tons in 1996 and 14,000 tons as recently as 1993. The San Rafael Mine, in the southern Andean region of Puno, reportedly has tin ore reserves of 12 million tons with tin grades ranging from 5.2% to 6.5%, making it one of the world's richest deposits. Minsur began operating its new $30 million Funsur tin refinery in mid-1996, with an initial production capacity of 30,000 tons of tin-in-concentrate. A second stage expansion scheduled for 1999 would lift metal production capacity to 20,000 tons per year and concentrate treatment capacity to 40,000 tons per year, as well as raising tin purity to 99.99% with the installation of an oxygen plant. Minsur also was developing a $5 million, 80-kilometer transmission line to tap into energy generated by the Machu Picchu hydroelectric powerplant. The company estimated that the project could save it $2 million per year in energy costs (Platt's Metals Week, 1997d).

Russia.—About $5 million reportedly has been invested in the Novosibirsk tin smelter to expand its solder and alloy production, boosting annual capacity to 3,000 tons, a 20% increase over that of 1995. Novosibirsk continued to operate at about 65% of its annual capacity of 20,000 tons of refined tin. The average grade of tin concentrate being treated was 52%. About 40% of its tin concentrate feedstock was imported from China, Nigeria, Peru, Portugal, and the United Kingdom. Tin mines, such as Deputansky Gok, Hingan Gok, Khrustalny Gok, and Solnechniy Gok, provided the smelter with the remaining 60% of its tin concentrate feedstock (Metal Bulletin, 1997d).

Singapore.—The LME called on the tin industry to consider including Singapore as a delivery point for the LME tin contract. The LME generally selects delivery points on the grounds of proximity to consumer markets, and Asia has become a major consumer of tin. The LME's tin committee recommended that if Singapore became an approved location, then tin deliveries should begin after January 1999 (Platt's Metals Week, 1997c).

Slovakia.—U.S. Steel Corp. (Pittsburgh, PA) announced that it will form a 50-50 joint venture with VSZ AS, the largest producer of flat-rolled steel in Slovakia, to meet the growing demand for tin mill products in Central Europe. U.S. Steel indicated that the joint venture would increase the annual tin mill product capacity by 200,000 tons at VSZ's Ocel plant in Kosice, Slovakia. The Ocel plant has a tin mill production capacity of 140,000 tons. The joint venture was expected to begin on January 1, 1998 (American Metal Market, 1997e).

Turkey.—The Government-owned Eregli Iron and Steel Works announced a tinplate expansion. NKK Corp., Marubeni Corp., and Mitsubishi Electric Corp., all Japan-based, have won a contract to supply an electrolytic tinning line at the Erdemir plant. The full turnkey order, worth about $90 million, includes a 250,000-ton-per-year electrolytic tinning and tin-free-steel combination line and a 300,000-ton-per-year shearing line. These facilities are expected to start production near the end of 1999 and will probably replace an existing 100,000-ton-per-year-capacity line. Erdemir officials reportedly are also considering modernizing this older line, which would increase tin-plate capacity to 350,000 tons per year (CRU International, 1997e).

United Kingdom.—Officials at South Crofty, the United Kingdom's only remaining tin mine, announced that they had reduced operating costs by 12% in 1996. They also announced that South Crofty had completed its mine development program, which started in 1994 when South Crofty Holdings Corp., based in Canada, took ownership of the mine. In 1997, mine production was expected to reach 200,000 metric tons of ore, reportedly at an average grade of 1.5% tin and a mill recovery rate approaching 90%. Demonstrated reserves were reported to be 833,000 tons (Metal Bulletin, 1997a).

Current Research

ITRI, based in Uxbridge, United Kingdom, the world's foremost laboratory for tin scientific research and new tin applications, completed its third full year under its new structure. It is now privatized, with funding supplied by several major tin producers and user firms rather than by the Association of Tin Producing Countries as had been the case in earlier years. ITRI announced that it had added Gwalia Consolidated Ltd., the Western Australian mining and mineral processing company, as a full member with a position on the supervisors council. Tin production is a fairly minor part of Gwalia's mining output, at 500 tons per year. The company's Greenbushes Mine, which is 200 kilometers south of Perth, has produced tin almost continuously since 1888. The tin concentrate is smelted on site, and the tin metal is cast into ingots from an electric arc furnace (Tin International, 1997a).

ITRI announced its goal to increase worldwide tin demand from 20,000 to 30,000 tons per year within 3 years. The two main areas where ITRI expects to accomplish this goal are in lead-free solders for the plumbing and electronics industries and in inorganic tin compounds as a replacement for antimony in flame-retardant chemicals. The lead-free solders could mean an extra 15,000 to 20,000 tons per year of consumption, and the introduction of a 97% tin-3% copper plumber's solder could add another 3,000 tons. The use of tin in fire retardants for polymeric materials could represent from 11,000 to 14,000 tons per year of additional tin use (American Metal Market, 1997a).

In recent years, tin consumption in lead-acid batteries has been increasing. In 1991, a research project was started by the Advanced Lead-Acid Battery Consortium to investigate ways to improve battery performance. Their work has led to evidence that increased tin content in the lead-calcium-tin alloy used for battery grids was beneficial in improving grid corrosion resistance and other battery properties. Lead-acid batteries have traditionally contained about 0.2% tin in the battery grids, but increasing the tin content to 1.5% improves power capacity, recharge speed, and resistance to higher underhood temperatures in automobiles. One small segment of the lead-acid battery market, known as valve-regulated batteries, has been converting to a 98% lead - 2% tin alloy for the "top leads" (the straps connecting the grids); these value-regulated batteries, although commanding only about 10% of the lead-acid battery market, are the fastest growing sector. The United States has generally been in the forefront of these battery conversions that result in increased tin

content. Asia generally does not use lead-calcium-tin alloys for grids. Europe is just beginning to try the new higher tin alloy (American Metal Market, 1997d).

In Canada, Northern Telecom Corp. (Nortel) announced that it had developed interconnection technology for making printed circuit boards without using lead and that it is making a test group of office telephones for market trial using the lead-free boards. Test results were said to be encouraging. The solder used was 99.3% tin-0.7% copper (Soldering Bits, 1997a).

In France, paintmaker Peintures Renaudin announced the development of an electrically conductive paint that can be applied to walls to provide interior room heat. By connecting a 12-volt battery to the painted surface via two electrodes, the painted surface reportedly can be heated rather quickly. The firm attributed the addition of conductive tin and antimony oxides as being critical to the resistive heating of the paint. The surface of the painted wall could even be covered with ordinary acrylic paint, wallpaper, or tiles. The firm originally intended the paint as a way to warm up drafty French country homes in the winter. Now it envisions its use on water pipes to prevent freezing in the winter, and use in heating systems for cars and trucks (Business Week, 1997).

In Japan, reports indicated that the development of lead-free solders for use in the automotive and consumer electronics sectors was gaining pace. Although no regulations to restrict the use of lead in these applications have been introduced in Japan, there was some concern in Japan that tariffs or import bans could be placed in Europe or the United States on products containing lead. Solders usually consist of tin-lead alloys, with other metals added to impart specific properties. Eliminating lead from solder raises the melting point and reduces the wettability and mechanical strength of the alloys, which can be detrimental in automotive applications—where safety is paramount. Taiho Kogyo Co. Ltd. is a leading Japanese producer of automotive bearing alloys and is affiliated with the Toyota Group. In a joint venture with Toyota's central research institute, the firm has developed a tin-silver-bismuth alloy for use as a solder in automotive applications. Silver raises the mechanical strength of the solder and lowers its melting point. Bismuth additions are restricted to 3% or less because larger additions harden the alloy and make it more difficult to process solder in wire form. The new solder reportedly is suitable for use in automotive applications because it can withstand repeated heating and mechanical vibration. Taiho Kogyo now produces the solder in rod and wire form and is developing it in paste form. Senju Metal Industry Co. Ltd. is the largest Japanese producer of solders. In a joint venture with Matsushita Electric Industrial Co., Ltd., Senju has developed a tin-zinc-silver-bismuth solder alloy in paste form for use in the assembly of consumer electronic equipment, such as televisions and VCR's (Roskill's Letter From Japan, 1997).

A tin-zinc alloy with a melting temperature of 190° C is said to be favored over other candidate lead-free electronics solders in Japan. In 1996, Mitsui Mining and Smelting Co. and Harima Chemicals Inc. began shipping samples of tin-zinc alloys mass produced in the form of a paste containing a mixture of powdered alloy and flux. In 1997, Matsushita Electric Industrial Co. and Senju Metal Industry Co. developed a special type of flux that enables tin-zinc to be used in open air. Previously, because of zinc's high activity, zinc-containing solder could only be used in a nitrogen atmosphere. Both products are said to have bonding, tensile strength, and electrical conductivity matching the levels in eutectic (67% tin-33% lead) solder, the standard formulation for electronic applications (Soldering Bits, 1997b).

Nihon Almit Corp. has developed new low-lead and lead-free lines of solders. Almit KS1 has an assay composition of 96.50% tin, 1.50% silver, and 2.00% bismuth, and Almit KS2 has 91.50% tin, 5% lead, 1.48% silver, and 2.00% bismuth. Nihon reported both solders to have acceptable melting points, slightly higher than the traditional 60% tin-40% lead solder used for plumbing and conventional metal-joining applications (ITRA Market Monitor, 1997a).

Outlook

Domestic demand for primary tin is expected to grow slowly in the next few years, at a rate of perhaps 1% per year. If, however, new applications, especially those in which tin is substituted for toxic materials, find acceptance in the marketplace, then that rate could double by 2002.

World tin reserves appear to be adequate to meet the foreseeable demand. Secondary sources of tin seem likely to remain an important component of tin supply, especially in the United States. The U.S. Government stockpile appears likely to remain in a selling mode in coming years, remaining an important segment of domestic tin supply. It seems quite likely, however, that domestic tin needs will be met primarily through imports.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT TIN STATISTICS 1/

(Metric tons of contained tin, unless otherwise specified)

	1993	1994	1995	1996	1997
United States:					
Production:					
Mine	W	--	--	--	--
Secondary e/	12,000	11,700	11,600	11,600 r/	12,300
Exports, refined tin	2,600	2,560	2,790	3,670	4,660
Imports for consumption, refined tin	33,700	32,400	33,200	30,200	40,600
Consumption:					
Primary	34,600	33,700	35,200	36,500	36,100
Secondary	11,900	8,530	10,800	8,180	8,250
Stocks, yearend, U.S. industry	10,800	10,400	11,700	10,900 r/	11,100
Prices, average cents per pound:					
New York market	239.17	254.93	294.54	288.10	264.45
Platt's Metals Week composite	349.80	369.14	415.61	412.43	381.49
London	233.00	248.00	282.00	279.00	256.00
Kuala Lumpur	231.58	244.76	277.50	275.19	252.24
World: Production:					
Mine	190,000 r/	178,000 r/	194,000 r/	208,000 r/	211,000 e/
Smelter:					
Primary	193,000 r/	197,000 r/	204,000 r/	212,000 r/	196,000 e/
Secondary	19,900 r/	19,100 r/	19,000 r/	16,800 r/	17,500 e/
Undifferentiated	1,180 r/	200 r/	200 r/	200 r/	200 e/

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.
1/ Data are rounded to three significant digits.

TABLE 2
U.S. CONSUMPTION OF PRIMARY AND SECONDARY TIN 1/

(Metric tons of contained tin)

	1996	1997
Stocks, Jan. 1 2/	9,300 r/	9,100
Net receipts during year:		
Primary	39,200	38,900
Secondary	2,750 r/	2,360
Scrap	6,140 r/	6,010
Total receipts	48,100 r/	47,300
Total available	57,300 r/	56,400
Tin consumed in manufactured products:		
Primary	36,500	36,100
Secondary	8,180	8,250
Total	44,700	44,300
Intercompany transactions in scrap	207 r/	138
Total processed	44,900 r/	44,500
Stocks, Dec. 31 (total available less total processed)	12,500 r/	11,900

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes tin in transit in the United States.

TABLE 3
U.S. CONSUMPTION OF TIN, BY FINISHED PRODUCT 1/

(Metric tons of contained tin)

Product	1996			1997		
	Primary	Secondary	Total	Primary	Secondary	Total
Alloys (miscellaneous) 2/	W	W	W	W	W	W
Babbitt	617	234	851	683	226	909
Bar tin	1,150	W	1,150	661	W	661
Bronze and brass	1,100	1,660	2,760	1,330	1,830	3,160
Chemicals	7,520	W	7,520	8,170	W	8,170
Collapsible tubes and foil	240	W	240	314	W	314
Solder	10,700	4,880	15,600	11,300	4,660	15,900
Tinning	2,050 r/	W	2,050 r/	1,140	W	1,140
Tinplate 3/	9,340 r/	W	9,340 r/	9,350	W	9,350
Tin powder	573	W	573	W	W	W
Type metal	W	W	W	W	W	W
White metal 4/	1,260	77	1,340	754	W	754
Other	1,900	1,320	3,230	2,420	1,540	3,960
Total	36,500	8,180	44,700	36,100	8,250	44,300

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes terne metal.
3/ Includes secondary pig tin and tin acquired in chemicals.
4/ Includes pewter, britannia metal, and jewelers' metal.

TABLE 4
U.S. INDUSTRY YEAREND TIN STOCKS 1/

(Metric tons)

	1996	1997
Plant raw materials:		
Pig tin:		
Virgin 2/	7,390 r/	7,460
Secondary	714 r/	692
In process 3/	1,130 r/	1,130
Total	9,230 r/	9,280
Additional pig tin:		
Jobbers-importers	1,440	1,370
Afloat to United States	211	488
Total	1,650	1,860
Grand total	10,900 r/	11,100

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes tin in transit in the United States.
3/ Data represent scrap only, tin content.

TABLE 5
TIN RECOVERED FROM SCRAP PROCESSED IN
THE UNITED STATES, BY FORM OF RECOVERY 1/

(Metric tons, unless otherwise specified)

Form of recovery		1996	1997
Tin metal 2/		W	W
Bronze and brass e/ 3/		11,400 r/	12,200
Lead and tin alloys:			
Antimonial lead		171	149
Babbitt		34	W
Type metal		37	W
Other alloys 4/		W	W
Total		242	149
Tin content of chemical products		W	W
Grand total		11,600 r/	12,300
Value e/ 5/	thousands	$106,000 r/	$104,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes tin metal recovered at detinning and other plants.
3/ Includes tin recovered from copper-, lead-, and tin-base scrap.
4/ Includes foil, solder, terne metal, and cable lead.
5/ Based on Platt's Metals Week composite price.

TABLE 6
U.S. STOCKS, RECEIPTS, AND CONSUMPTION OF NEW AND OLD SCRAP AND TIN RECOVERED,
BY TYPE OF SCRAP 1/

(Metric tons)

	Gross weight of scrap								
	Stocks,		Consumption			Stocks,	Tin recovered e/ 2/		
Type of scrap	Jan. 1	Receipts	New	Old	Total	Dec. 31	New	Old	Total
1996:									
Copper-base scrap	6,350	122,000	27,400	94,400	122,000	6,010	1,190	3,430	4,610
Brass mills 3/	--	45,900	45,900	--	45,900	--	885	--	885
Foundries and other plants	3,100	23,500 r/	10,000	14,000	24,000	2,660 r/	473	604 r/	1,080 r/
Total tin from copper-base scrap	XX	XX	XX	XX	XX	XX	2,540 r/	4,030 r/	6,580 r/
Lead-base scrap	30,200 r/	1,250,000 r/	52,800	1,200,000 r/	1,250,000 r/	31,200	1,390	3,680 r/	5,060 r/
Tin-base scrap 4/	W	W	W	W	W	W	W	W	W
Grand total r/	XX	XX	XX	XX	XX	XX	3,930	7,710	11,600
1997:									
Copper-base scrap	6,010	128,000	26,700	101,000	128,000	5,800	1,160	3,680	4,840
Brass mills 3/	--	47,300	47,300	--	47,300	--	1,010	--	1,010
Foundries and other plants	2,660	16,500	7,170	10,100	17,300	1,880	333	368	701
Total tin from copper-base scrap	XX	XX	XX	XX	XX	XX	2,510	4,040	6,550
Lead-base scrap	31,200	1,320,000	76,600	1,290,000	1,370,000	23,100	2,010	3,750	5,760
Tin-base scrap 4/	W	34	W	41	W	W	W	39	39
Grand total	XX	XX	XX	XX	XX	XX	4,520	7,830	12,300

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Tin recovered from new and old copper-base scrap, brass mills, and foundries.
3/ Brass-mill stocks include home scrap, and purchased-scrap consumption is assumed equal to receipts; therefore, line does not balance.
4/ Includes tinplate and other scrap recovered at detinning plants.

TABLE 7
U.S. EXPORTS OF TIN IN VARIOUS FORMS 1/

	Tinplate and terneplate		Ingots and pigs		Tin scrap and other tin bearing material except tinplate scrap 2/	
Year	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
1996	338,000	210,000	3,670	21,000	56,800	61,300
1997	349,000	206,000	4,660	27,400	34,500	45,900

1/ Data are rounded to three significant digits.
2/ Includes rods, profiles, wire, powders, flakes, tubes, and pipes.

Source: Bureau of the Census.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF TIN IN VARIOUS FORMS 1/

	Miscellaneous 2/	Dross, skimmings, scrap, residues, tin alloys, n.s.p.f.		Tinplate and terneplate		Tin compounds		Tinplate scrap	
Year	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
1996	$5,070	16,000	$58,800	251,000	$161,000	354	$3,120	64,600	$5,690
1997	5,890	4,110	14,600	261,000	166,000	389	3,210	34,300	5,120

1/ Data are rounded to three significant digits.
2/ Includes tinfoil, tin powder, flitters, metallics, manufactures, n.s.p.f.

Source: Bureau of the Census.

TABLE 9
U.S. IMPORTS FOR CONSUMPTION OF UNWROUGHT TIN METAL,
BY COUNTRY 1/

	1996		1997	
Country	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Australia	222	$1,260	500	$2,600
Belgium	23	241	160	979
Bolivia	6,290	39,200	6,680	38,600
Brazil	9,460	58,500	8,610	47,800
Canada	270	1,720	144	920
Chile	407	2,440	464	2,730
China	2,760	16,000	4,710	26,900
Hong Kong	--	--	258	1,530
India	898	5,720	1,720	9,940
Indonesia	7,550	47,000	7,610	43,000
Korea, Republic of	10	--	--	--
Malaysia	965	6,760	1,640	9,720
Netherlands	--	--	200	1,090
Peru	481	2,850	6,610	34,600
Russia	435	2,760	480	2,810
Singapore	120	750	120	666
Thailand	--	--	600	3,240
United Kingdom	243	1,550	20	118
Other	34 r/	200 r/	68	397
Total	30,200	187,000	40,600	228,000

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 10
TIN: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
Australia	8,057	7,495 r/	8,656	8,828	10,169 3/
Bolivia	18,634	16,169	14,419	14,802 r/	14,500
Brazil	26,500 r/	16,619 r/	17,317 r/	19,617 r/	18,500
Burma 4/	689	814	747	459 r/	400
Burundi	10 e/	-- r/	15 r/	25 r/	(5/)
Cameroon e/	3	2	2	1	1
China e/	49,100	54,100	61,900	69,600 r/	65,000
Congo (Kinshasa) 6/	-- r/	-- r/	--	--	--
Indonesia	29,000 e/	30,610	38,378	38,500 e/	47,000
Kazakstan e/	50	24	15	15	15
Laos e/	300	200	200	200	200
Malaysia	10,384	6,458	6,402	5,175 r/	5,100
Mexico	3	3 e/	1	2 e/	5 3/
Mongolia e/	150	100	150	100	50
Namibia	4	1	2	--	--
Niger e/	20	20	20	10 r/	10
Nigeria e/ 7/	200 r/	278 r/ 3/	600 r/	3,000 r/	3,000
Peru	14,310	20,275	22,331	27,004	27,952 3/
Portugal	5,334	4,332	4,627	4,800 e/	4,000
Russia	13,100	10,460	9,000 e/	8,000 e/	7,500
Rwanda	400 e/	50 e/	242 r/	200 r/	--
South Africa	450 e/	--	--	--	--
Spain	2	4	2 e/	2 e/	2
Tanzania	12 r/	9 r/	3 r/	--	--
Thailand	6,363	3,926	2,201	1,457 r/	750
Uganda e/	3 r/	3 r/	43 r/	(5/) r/	(5/)
United Kingdom	2,232	1,922	1,973	2,103	1,800
United States	W	--	--	--	--
Vietnam e/	3,500	4,000	4,500	4,500	4,700
Zambia	12 r/	9 r/	3 r/	--	--
Zimbabwe e/	800	100 r/	10 r/	10 r/	1
Total	190,000 r/	178,000 r/	194,000 r/	208,000 r/	211,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

1/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through June 25, 1998.

3/ Reported figure.

4/ Includes content of tin tungsten concentrate.

5/ Less than 1/2 unit.

6/ Formerly Zaire.

7/ Concentrate gross weight reported, estimated 62% Sn content.

TABLE 11
TIN: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
Argentina: e/					
Primary	145	100	100	100	100
Secondary	100	100	100	100	100
Total	245	200	200	200	200
Australia:					
Primary	222	315	570	460	605 3/
Secondary e/	250	260	300	300	300
Total e/	472	575	870	760	905
Belgium: Secondary e/	5,000	5,000	5,000	3,000	3,000
Bolivia: Primary	14,541	15,285	17,709	16,733 r/	16,100
Brazil:					
Primary	26,900	20,400	16,789 r/	18,371 r/	18,500
Secondary e/	250	250	250	250	250
Total e/	27,200	20,700	17,000 r/	18,600 r/	18,800
Bulgaria: Secondary	23	22	13 r/	8 r/	10
Burma: Primary	170	200 e/	190 e/	-- r/	--
Canada: Secondary e/	200	--	--	--	--
China: Primary e/	52,100 r/	67,800	67,700 r/	71,500 r/	61,000
Congo (Kinshasa): Primary e/ 4/	700 r/	100 r/	-- r/	-- r/	--
Czech Republic: Secondary e/	115	100	100	100	100
Denmark: Secondary e/	100	100	100	100	100
Germany: Primary and secondary	179	100	100 e/	100	100
Greece: Secondary e/	200	150	150	100	100
India: Secondary e/	200	100 r/	100	-- r/	--
Indonesia: Primary	30,415	31,100 e/	38,628	39,000 e/	40,000
Japan: Primary	804	706	630	524	507 3/
Korea, Republic of: Primary e/	-- r/	-- r/	-- r/	-- r/	--
Malaysia: Primary	40,079	37,990	39,433	39,195 r/	35,800
Mexico: Primary	1,640	768	770	1,234 r/	1,188 3/
Nigeria: Primary	169 r/	179	400 r/ e/	2,000 r/ e/	2,000
Norway: Secondary e/	90	90	70	50	50
Portugal: Primary and secondary e/	1,000	100	100	100	100
Russia: e/					
Primary	13,400	11,500	9,500	9,000	6,700
Secondary	1,000	1,000	1,000	1,000	1,000
Total	14,400	12,500	10,500	10,000	7,700
South Africa: 5/					
Primary	452	43	--	--	--
Secondary e/	45	--	--	--	--
Total e/	497	43	--	--	--
Spain: e/					
Primary	500	500	500	150	150
Secondary	200	200	100	50	50
Total	700	700	600	200	200
Thailand: Primary	8,099	7,759	8,243	10,981 r/	10,000
United Kingdom: Secondary e/	100	100	100	100	100
United States: Secondary	12,000	11,700	11,600	11,600 r/	12,300 3/
Vietnam: Primary e/	2,500	2,500	2,800	2,800	2,900
Zimbabwe: Primary	657	82	--	--	--
Grand total	215,000 r/	217,000	223,000 r/	229,000 r/	213,000
Of which:					
Total primary	193,000	197,000 r/	204,000 r/	212,000 r/	196,000
Total secondary	19,900 r/	19,100	19,000 r/	16,800 r/	17,500
Total undifferentiated	1,180 r/	200 r/	200 r/	200 r/	200

e/ Estimated. r/ Revised.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Wherever possible, total smelter output has been separated into primary (from ores and concentrates) and secondary (tin metal recovered from old scrap). This table reflects metal production at the first measurable stage of metal output. Table includes data available through July 3, 1998.

3/ Reported figure.

4/ Formerly Zaire.

5/ South Africa's only operating tin mine closed in early 1994.