

TIN

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Tin was not mined in the United States during 2000. Twenty-five firms consumed 86% of reported primary tin used domestically. The major uses were as follows: electrical, 24%; cans and containers, 21%; transportation, 14%; construction, 11%; and others, 30%. The estimated value of primary metal consumed domestically was about \$310 million. Industry stocks remained steady (tables 2 and 4).

About 17,600 metric tons (t) of tin in old and new scrap, including tin alloys, were recycled (table 5); of this about 6,600 t was old scrap. Almost one-fifth of the tin consumed in the United States was produced at 4 detinning plants and 45 secondary nonferrous-metal processing plants. Interest remained strong in the recycling of used tin cans, partly because of rising fees and limited space at landfills. The recycling rate for steel cans was 58% in 2000, compared with 58% in 1999, 56% in 1995, and 15% in 1988.

The Defense Logistics Agency (DLA), which manages the National Defense Stockpile (NDS), sold 12,000 t of pig tin from the stockpile during 2000. At yearend, 59,686 t remained in the stockpile.

World tin mine output increased by 10% (tables 1 and 9). Industry observers believed that world supply and demand were in approximate equilibrium. World tin smelter production increased by 2%. The average Platt's Metals Week composite price for tin rose by 1%.

Of the 22 countries in which tin was mined, the top 6 accounted for 91% of the world total of 238,000 t. China was the largest producer (41% of the world total) and was followed by Indonesia (20%), Peru (16%), Brazil (5%), Bolivia (5%), and Australia (4%) (table 9).

World tin reserves, estimated to be 8 million metric tons (Mt), were considered to be adequate to meet the world's future tin requirements. Assuming that world primary tin consumption will be about 200,000 metric tons per year (t/yr), these reserves would last 38 years. Most tin reserves are in Asia and South America.

Legislation and Government Programs

In 2000, the DLA sold 12,000 t of pig tin in the NDS to two companies. Both sales were long-term contracts allowing for deliveries of the tin over a 1-year period. Spot market sales of tin ended in 1999. The effect of NDS tin sales on domestic markets is assessed by the Market Impact Committee, composed of several Federal Agencies, including the U.S. Geological Survey (USGS). The NDS tin is stored at Government sites in Hammond, IN; Baton Rouge, LA; Point Pleasant, WV; and New Haven, IN. At yearend, the remaining unsold inventory was 59,686 t.

Production

Mine.—Tin was not produced at any U.S. mine in 2000. Until 1993, a few small tin mines had operated sporadically in the United States for many years. However, USGS canvasses confirm that there has been no domestic tin production since that year.

Secondary.—Industry observers believe the United States is the world's largest producer of secondary tin. Most secondary

Tin in the 20th Century

In 1900, the United States was the world's major tin user. Domestic tin production was modest and came mostly from Alaska. The Nation depended almost entirely on tin imports for its needs. Over 80% of the tin imported came from Malaysia, which was the world's dominant tin producer at the time. Statistics are not available, but there is evidence that solder and tinfoil were the major domestic uses for tin, with bronze and tinning next in importance. In 1900, all tinfoil was made by the hot-dip process on cut-length sheets. The electrolytic tinfoil process was developed in Germany in the late 1930s, under the impetus of accelerated production needed for Germany's war effort. By the early 1940s, the high-speed electrolytic process took hold in the United States, and by the mid-1960s hot-dipping was phased out. In 1939, tin became the first material purchased for a U.S. Government stockpile established for wartime use. From the late 1940s through the early 1950s, acquisitions of tin for the Government stockpile surged and reached a peak of about

500,000 metric tons. In 1959, Congress approved tin sales from the Government stockpile. Tin was the first material to be sold from the stockpile (1960) and was offered for sale almost continuously up to the end of the century when sales had reduced tin stockpile inventories to 60,000 tons. Since establishment of the Government stockpile in 1939, tin has almost always had the highest inventory value in the stockpile.

In 2000, the United States had no domestic tin mine or smelter production. The country was dependent mostly on imports for its tin needs. Peru was the major supplier, followed by China, Bolivia, Brazil, and Indonesia. The United States remained the world's largest user of tin. Solder was the dominant market for tin consumption domestically, followed by tinfoil, chemicals, and brass/bronze. The use of tin for tinfoil had declined sharply since 1960 due to competition in the beverage container sector from materials like aluminum and plastics. Tin chemicals represented a somewhat new market essentially starting in the early 1950s

tin was produced from various scrapped alloys of tin and recycled in those same alloy industries. In 2000, however, 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. Secondary tin from recycled fabricated parts was used in many kinds of products and was particularly important for the manufacture of solder and brass/bronze.

The former Steel Can Recycling Institute, created in 1988 and funded by five domestic tinplate producers to advance the collection, preparation, and transportation of steel can scrap, was in its sixth full year of expanded activities in 2000 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. Its representatives in various regions of the United States continued to work with municipalities, scrap dealers, and detinners to promote the recycling of tin cans. The SRI announced that the recycling rate for steel cans, most of which are made from tinplate, remained at about the same rate (58%) as in 1999 (Steel Recycling Institute, 2001).

APEAL, a Belgium-based organization of European packaging firms that use considerable amounts of tinplate, released 1999 data on the recycling of steel packaging in Europe. The data indicated a marked increase in recycling rates for most countries in the European Union (EU). The overall rate for recycling was 46%. Germany ranked first with an 80% recycling rate, mostly due to its selective, multimaterial collection system. Integral collection and magnetic separation prior to incineration still account for over one-half of recycled steel packaging in the EU, but the more recent introduction of curbside collections and recycling banks has been so successful that APEAL considers the combined approach as essential (Metal Bulletin Monthly, 2000b).

Consumption

In 2000, domestic consumption of primary tin remained almost identical to that of 1999. Secondary consumption increased slightly. Domestic consumption data for tin were developed by the USGS from a voluntary survey of tin consumers. Of the 149 firms to which a survey form was sent, 125 responded, for an 84% response rate (table 3).

In 2000, tinplated steel and tin-free cans accounted for 23% of the 136 billion metal cans shipped domestically; aluminum cans accounted for the remainder. The proportions were the same as in 1999. Steel tinplate dominated in the food, pet, and the "general line" can markets, and aluminum held 100% of the beverage can market (Can Manufacturer's Institute, 2001).

The U.S. Steel Group of USX Corp. (Pittsburgh, PA) announced late in the year that it would acquire the tin mill products business of LTV Corp. (Cleveland, OH); the acquisition was completed early in 2001. The tin mill products operations that were acquired are in Aliquippa, PA, and East Chicago, IN. Upon takeover, U.S. Steel shutdown the Aliquippa facility. Under the terms of agreement with LTV, U.S. Steel assumed about \$95 million of LTV's employee related obligations, including shutdown benefits for about 400 workers at the tin mill in Aliquippa, PA, and the assumption of pension, medical, and life insurance obligations for all employees. About one-half of the expense was covered by U.S.

Steel's overfunded pension plan. The LTV purchase made U.S. Steel Corp. the Nation's major producer of tin mill products. In acquiring LTV's 500-employee tin mill at its large Indiana Harbor Works in East Chicago, IN, U.S. Steel boosted its capacity to produce tin-coated sheet to about 1.7 million metric tons per year (Mt/yr). U.S. Steel tin mills at its large Gary, IN, works and at its smaller Fairless Works (Fairless Hills, PA) together can produce about 1.3 Mt/yr. The domestic tinplate market is estimated to be about 4.5 Mt/yr (American Metal Market, 2000).

Weirton Steel Corp. (Weirton, WV) announced that it will enter the coated coil industry when it begins a new polymer film coating line during the first half of 2001. The planned line will have the capacity to apply a thin coat of polymer film on 200,000 t/yr of tinplated steel. Several sites for the facility are being considered. The polymer coating process is a new technology that reportedly is superior to conventional lacquer coating systems. Polymer-coated tinplate is used for the top and bottom lids of food containers, aerosol cans, and other containers. Weirton has been the largest U.S. tinplate producer for many years and is the eighth largest domestic integrated steel company (Weirton Steel Corp., 2000).

Prices

The Platt's Metals Week average composite price for tin metal rose by 1% during 2000 compared with that of 1999. The Platt's Metals Week average commodity price was \$3.98 per pound in January, its highest monthly level all year. And, it ended the year at \$3.59 per pound, in December, its lowest monthly level all year.

The London Metal Exchange (LME) remained the primary trading arena for tin. Tin was one of only six metals to be traded on the LME; the other metals included aluminum, copper, lead, nickel, and zinc. The LME announced the start of trading on its new LMEX contract on April 10. LMEX is a futures-based weighted index contract covering the six primary nonferrous metals traded on the LME. The new index uses a base of 1,000 points calculated from January 4, 1999. At the end of the first day's trading, the index stood at 1,270 points. LMEX is designed to attract the institutional investor by spreading liquidity across all the metals and thus reducing volatility in each metal contract. Initially, LMEX had 15 of the 40 LME member firms involved in the new contract. Other firms are expected to follow (Tin International, 2000b).

The LME announced that it was considering the storage of tin in Singapore. In the past, Singapore had been ruled out for such tin storage because it is near sizable production facilities, and the LME's policy has been to site delivery points in areas of net consumption (Platt's Metals Week, 2000c).

The Kuala Lumpur Tin Market (KLTM) announced that it had received the needed approvals for trading its tin contracts in United States dollars. Its board subsequently decided to change contract pricing from the Malaysian ringgit to the dollar starting on February 2, 2001. The KLTM was established in 1984 as a physical market to provide facilities for buying and selling tin and for the daily determination of tin prices. Its contract calls for trading tin on warrants for prompt delivery, within four business days, of the following brands: MSC (Malaysia), Thaisarco (Thailand), and Bangka and Mentok (both Indonesia).

The KLTM daily price quotation has been traditionally used as a reference price for contract pricing for producers and consumers in the Asia-Pacific region, which produces over 80% of the world's tin. Along with the change to a dollar contract, the KLTM board also decided to introduce electronic daily trading to replace the current pit system of daily price setting. This new system is to be implemented by June 2001 (Tin International, 2000b).

Trade

U.S. imports of refined tin, which supplied most domestic tin requirements, decreased by 5% in 2000. Imports of tin in all forms (ore and concentrate, metal, waste, and scrap) remained duty free (tables 7 and 8). In the United States, trading firms marketed most of the tin metal imported from a variety of countries and then warehoused in this country until sold to customers. Foreign-owned trading firms tended to dominate the domestic field.

Imports of refined tin to the United States were dominated by China and Peru. Bolivia, Brazil, and Indonesia ranked next in importance. Tin exports were small compared with imports (table 6).

After the U.S. Department of Commerce assessed antidumping duties of over 95% against four Japanese tinplate producers, based on an investigation covering a period from October 1, 1998, through September 30, 1999, the U.S. International Trade Commission (ITC) imposed a 95% antidumping duty on most tinplate imports from Japan. The final affirmative injury determination drew a strong negative response from Japanese tin mill owners because the ITC found injury in a case that had only one domestic tin mill petitioner, Weirton Steel Corp., Weirton, WV. Weirton, the only one of seven major U.S. tinplate producers to file the antidumping petition, claimed that the ITC ruling was crucial for the company's long-term viability. Weirton has been the largest U.S. tinplate producer for many years, with a 22% market share. The ITC's 95% duty will apply to imports from Kawasaki Steel Corp., Nippon Steel Corp., NKK Corp., and Toyo Kohan Corp., the major Japanese tinplate exporters. The United States imported about 337,000 t of tinplate from Japan in 1999, up from an average of about 210,000 t/yr in the prior 3 years (Metal Bulletin, 2000h).

World Review

Argentina.—Sunshine Mining and Refining Co. (USA) announced that it is still attempting to find sources of funding to develop its Pirquitas silver-tin-zinc mine in Argentina. The company has had an operating permit since 1999 but has been frustrated by financing problems arising from the low price of silver. Sunshine, primarily a silver miner, originally bought the mine in 1995 for \$1.7 million. The property had been mined for many years by local operators who went into liquidation in 1990. Sunshine has since invested \$20 million in the project (Tin International, 2000b).

The country's only tinplate producer, Siderar SAIC, returned its only tinning line to production following modernization by Techint Technologies Co. (Pittsburgh, PA). The line's speed was increased from 244 meters per minute to 305 meters per

minute. The line's capacity is now 150,000 t/yr compared with a previous 120,000 t/yr. Siderar's tinning line produces mainly for domestic markets (Metal Bulletin, 2000f).

Australia.—Murchison United NL announced an agreement with the Tasmanian State Government to jointly fund a \$22 million, 6-year exploration and development program aimed at securing the long-term future of the company's Renison Bell tin mine. This new program will enhance a prior \$13 million program already underway at Renison designed to convert existing inferred resources to reserves and extend mine life beyond 10 years. Murchison acquired Renison in 1998 and has since been transforming it into one of the world's lowest-cost tin mines.

Marlborough Resources NL Group announced that it had reached an agreement to acquire a subsidiary of Western Metals Ltd., which owns the defunct Ardlethan tin mine, for an agreed purchase price of \$1. Marlborough will take responsibility for rehabilitation of the old tin project, which was closed down in 1986. Tailings dams at the site contain about 8 Mt of tailings with a grade of about 0.19% tin. Thus, about 15,000 t of tin are contained in the tailings, which have a current in-situ value of about \$90 million. Marlborough has conducted several detailed studies of these tailings over the past 20 years and believes that recoveries of between 55% to 65% may be possible depending on the process used. The firm also will be conducting further test work on the site to determine the most economical process and equipment to maximize profitability from the treatment of tailings. The firm plans to transport the retreated tailings back into the original open cut. In addition to the tailings, there are significant alluvial tin resources on some of the 53 mineral tenements included with the acquisition (Tin International, 2000e).

Phelps Dodge Corp. (USA) announced that it agreed to join the Australian company, Platsearch Ltd., in its Tara copper-zinc-tin exploration project in New South Wales. Under the terms of the agreement, Phelps Dodge can earn a 60% stake in Tara by spending \$1.2 million on a ground magnetic survey and a 400-meter drill hole. Once Phelps Dodge has earned its 60%, Platsearch and its existing partner, Nosebi Mining and Management, will participate at 32% and 8%, respectively. Previous drilling at Tara intersected narrow widths of copper-zinc-tin mineralization. Phelps Dodge planned to begin drilling in 2000 (Platt's Metals Week, 2000e).

Bolivia.—The ownership of the Vinto tin smelter and the Huanuni tin mine completely transferred to Allied Deals Corp. Allied paid \$15 million for the smelter and associated assets and also paid \$500,000 for a 30-year lease on what may be the world's largest underground tin mine. Vinto produces about 11,000 t/yr of low-lead tin. Allied plans to increase production at Vinto to 15,000 t/yr in 2001-2002 and then to further increase output to 18,000 to 20,000 t/yr in 2 more years. Also, new sources of tin concentrate would be sought; Vinto's feedstock now comes from Bolivia and Brazil (Platt's Metals Week, 2000g).

Brazil.—The country's largest steelmaker, Companhia Siderúrgica Nacional (CSN), announced that it was seeking contractors to modernize the company's no. 3 and no. 5 electrolytic tinning lines at its Volta Redonda Works. Work is expected to start in January 2001 on the \$150 million modernization. The upgrade will allow CSN to produce thinner

and more sophisticated grades of tinplate, including double-reduced grades as well as drawing and ironing grades for two-piece beverage cans. CSN has six tinning lines at Volta Redonda with a combined capacity of 1.1 Mt/yr of tinplate. CSN is the world's fifth largest tinplate producer and the largest on a single site. About 70% of CSN's tinplate output is used domestically and 30% is exported (Metal Bulletin, 2000b).

Chile.—The largest Chilean steel producer, Compañía Siderúrgica Huachipato (CSH), a subsidiary of Chile's Cap Group, celebrated its 50th anniversary. CSH is Chile's only integrated steelmaker. Located along the San Vicente Bay in southern Chile, the plant employs almost 3,000 workers and has the capacity to produce 1.2 Mt/yr of steel. Among its several finishing mills is a tin mill with a Ferrostan electrolytic tinning line that has an annual capacity of 100,000 t (Metal Bulletin Monthly, 2000a).

China.—The Government of China, the world's largest tin producer, announced that it will seek to attract foreign investment for mining in Xinjiang Province, in northwestern China. The Government intends to adopt preferential policies to attract foreign capital to tap vast resources of natural gas, coal, and nonferrous metals in Xinjiang along with state-owned mining enterprises. Foreign companies that invest in Xinjiang will be eligible for exemption from fees for mining rights in the first year and a subsequent 50% reduction for the next 2 years. Wholly owned foreign companies and joint ventures will be exempt from mineral resource compensation fees for 5 years. Also, the Government will seek to attract investment by issuing stocks, holding assets sales, and franchising. China believes these moves would accelerate its entry into the World Trade Organization and further lift its economy. Geologists working in Xinjiang recently discovered deposits of copper, nickel, lead, zinc, and tin near the province of Urumqi, an estimated total of about 1.2 Mt of base metal ores in an area covering almost 860,000 square kilometers (Metal Bulletin, 2000a).

The country's major tin producer, Yunnan Tin Corp., announced that it expected a delay in the completion of its new furnace, citing technical difficulties. Officials projected a late 2001 startup. Yunnan is upgrading its 24,000 t/yr tin smelter in Gejiu City by replacing several reverberatory furnaces with a new furnace. The furnace will continue to process 50,000 t/yr of concentrate and produce 24,000 t/yr of refined ingot. Yunnan has invested \$12 million in the upgrade. In 2000, Yunnan continued to target a maximum output of 24,000 t of refined tin, which is in-line with 1999 production (Platt's Metals Week, 2000h).

Denmark.—The Government announced plans to impose a wide-ranging ban on the use of lead. It would be the first country to do so. The ban becomes effective March 1, 2001, and will affect the use of lead and lead compounds in the construction and electronics industry, use of lead as a stabilizer in plastics, and use of metallic lead in ballasts and weights. The ban has implications for tin because tin is often used as a replacement for lead in such applications (Mining Journal, 2000b).

Germany.—The Government was considering extending its deposit system for used beverage containers to include disposable steel (tinplate) and aluminum cans. According to the deposit proposal, a fee of 50 pfennigs (49 cents) would be imposed on each disposable can as well as on glass and plastics

bottles. The deposit would be refunded when the container is returned. Glass or plastic bottles already carry a deposit of between 15 and 70 pfennigs each. All other beverage packaging currently is discarded, although much of it enters the recycling chain. In Germany, over 90% of cans are made from steel, amounting to roughly 170,000 t of tinplate. Recycling of tinplate is now at about 80% in Germany, the highest rate in Europe (American Metal Market, 2001).

The country's only tinplate producer, Rasselstein Hoesch GmbH (RHG), owned by ThyssenKrupp AS announced plans to shutter one of its plants in an attempt to bolster profitability. The plant to be closed is RHG's Dortmund facility, with a tinplate capacity of 180,000 t/yr. Its closure is set for three stages, with operations to cease completely by the end of 2001. RHG has its main plant in Andernach, with tinplate capacity of 900,000 t/yr. Its capacity is to be expanded to 1 Mt/yr by the end of 2001 (Tin International, 2000f).

Indonesia.—PT Timah, the country's largest tin producer, announced an anticipated decline of 12% in its refined tin output during 2000. The company attributed lower output to predicted poor weather and declining resources. Timah is still attempting to resolve long-standing land ownership issues with local inhabitants on the islands of Bangka and Belitung, the sites of most of its tin mining and smelting. Timah acknowledged that additional uncertainty looms as the Indonesian Government appears set to declare Bangka Island as a province, possibly giving local authorities autonomous powers. If that becomes a reality, the company may be forced to pay separate royalties to the local Bangka provincial administration. Timah is currently seeking opportunities to expand its tin operations into Burma, Cambodia, and Vietnam (Metal Bulletin, 2000d).

The Government announced that it has granted PT Koba Tin a 10-year extension of its contract to operate in Indonesia. Koba Tin is 75% owned by Iluka Resources NL (Australia). Koba has been mining tin at a rate of 10,000 t/yr (Platt's Metals Week, 2000b).

Herald Resources Ltd. (Australia) announced the discovery of significant tin mineralization during a drilling program at its Batu Besi property on Belitung Island. Tin values in the range of 1.2% have been reported. The island has long been home to major tin mining operations of PT Tambang Timah (Mining Journal, 2001a).

Japan.—The country's tinplate industry finds itself in an acutely competitive market. Over the past 4 years, consumption of beverages in tinplate cans has fallen as part of an overall decrease in the consumption of canned beverages in Japan. The tinplate makers are facing greater competition from popular, portable half-liter plastic bottles that have garnered a growing share of the packaging market for carbonated and noncarbonated beverages. In 1999, about 35 billion cans made of tinplate, tin-free steel (TFS), and aluminum were used in Japan. This total represent an 8% decline in can consumption compared with about 38 billion cans used in 1998, and a 13% decline compared to the 40 billion cans used in 1996. Steel cans are estimated to account for about 60% of all cans used in Japan; of these, tinplate and low-tin cans represent 35%, while TFS cans account for the remaining 25% share; aluminum cans represent the other 40% share of the can market.

In 1999, Kawasaki Steel Corp. produced 25,000 metric tons

per month (t/mo) of tinplate a month for local sale and export; about 11,000 t/mo of TFS was produced for local and overseas sale. Kawasaki's output included a low-tin coated steel designed for making three-piece cans. In the production process, an iron-nickel-tin alloy layer is formed by electroplating and a flow melting process. The low-tin product accounts for 25% of the firm's tinplate output. Most of the product is supplied to Japanese canmakers to make beverage cans for coffee and sports drinks.

In 1999, Kawasaki exported a total of 170,000 t of tinplate. One-half of the firm's tinplate exports are shipped to the United States, while other big markets are China, Indonesia, and the Philippines. Until recently, Japanese steel mills supplied about 350,000 t/yr of tinplate to the United States, accounting for almost 10% of the U.S. tinplate market. In 1999, Kawasaki supplied 88,000 t of tinplate to U.S. customers, representing 25% of total Japanese tinplate exports to the United States (Tin International, 2000a).

Korea, Republic of.—This country, with four tinplate producers, has become a major force in the tinplate market during the past decade. The Republic of Korea's tinplate consumption is estimated at 385,000 t/yr, and imports account for about 25,000 t of that total. Pohang Iron and Steel Corp. (POSCO) was the country's leading domestic tinplate market supplier with an estimated 31% market share in 1999, representing tinplate sales of 110,000 t/yr. The second largest local supplier was Dongbu Steel Corp. with sales of 96,000 t in 1999, or about a 27% market share. In third place was Dongyang Corp. with an estimated 26% domestic market share, or 92,000 t of sales. Shinwha Corp. was in fourth place with sales of 57,000 t and a 16% local market share. Both Dongbu and Dongyang have a larger tinplate manufacturing capacity than POSCO but rely on exports for about one-half their sales. Export orders are important to all four tinplate makers. In 1999, Dongbu and Dongyang were expected to ship export orders far exceeding their domestic sales, while POSCO and Shinwha were expected to supply about one-half of their output to domestic customers. The Republic of Korea's total tinplate-making capacity is about 850,000 t/yr, almost one-half of which is used for export purposes.

Dongbu overtook Dongyang as the Republic of Korea's largest tinplate producer with the startup of its Asan Bay electrolytic tinning line that has a top speed of 650 meters per minute. Dongbu is now able to produce 280,000 t/yr of tinplate; Shinwha produces 90,000 t/yr. The other producer, POSCO, ranks as one of the world's major steel companies and has an annual production of 770,000 t of blackplate substrate. In addition to supplying the domestic market, POSCO exports about 75,000 t/yr. POSCO's main tinplate markets are India and Southeast Asia (Tin International, 2000e).

Malaysia.—The long, narrow, and highly productive Southeast Asian Tin Belt extends over the entire length of the Malay peninsula. It includes parts of Burma and Thailand to the north as well as Malaysia and some western Indonesian islands to the south. The Malaysian portion of the Tin Belt contains about 40% "acid intrusives," presumably granite, mostly in three very long, irregular intrusive zones. These zones generally parallel the north-south trend of the peninsula. The largest of the three, in west-central Malaysia, extends into Thailand. It resembles the Sierra Nevada, CA, and the adjacent

Coast Range, British Columbia, Canada, intrusive belts in Western North America. Host rock for the Malaysian intrusive is mostly Paleozoic sedimentary rock with minor volcanics. Malaysian bedrock tin deposits are presumed to be closely associated with a small Permian-to-Triassic-age granite center within the three much larger regional granite masses.

Most of Malaysia's tin mines are in the States of Perak and Selangor. In an attempt to revitalize the tin industry, officials in Perak issued mining licences during 2000. However, Government assistance to find and develop tin prospects reportedly has been lacking in recent years. In 1989, the Government requested the United Nations (UN) to study the situation and make recommendations. In 1991, a UN report was submitted, and the Malaysian Federal Parliament took legislative and regulatory actions in response. Because Malaysian States have autonomy over mining matters, however, the Federal initiatives must await acceptance by the States. Selangor and Sebah States have already accepted the initiatives. The belief is that sufficient resources are available. Presumably, all that is needed to return Malaysia to prominence in tin mining is increased Government support for investment, exploration, and development in the mining sector (Engineering and Mining Journal, 2000).

The Chamber of Mines announced that there were 45 active tin mines in the country in October 1999, 15% more than the 39 mines active in January 1999. Despite this, tin mine output has remained about the same (Platt's Metals Week, 2000d).

Nigeria.—Malaysia Mining Corp. (MMC) was reportedly close to signing an agreement with the Nigerian Mining Corp. (NMC). NMC is a Government-owned entity that holds the leases to most mining rights in the country and manages controlling shares in Consolidated Tin Mines Ltd. NMC officials acknowledged that Nigeria's tin properties require fresh investment and new technologies. MMC has been seeking new opportunities to invest in tin and other metal operations outside Malaysia and further utilize its lengthy mining experience (Metal Bulletin, 2001).

Peru.—The country's major tin miner, Minsur, announced plans to invest \$7 million this year in exploration work. During 1999, Minsur completed an expansion at its mine, increasing the production rate from 1,500 metric tons per day (t/d) of tin ore to 2,500 t/d. As a result, the company expects to produce about 3,500 t/yr of tin-in-concentrate. Minsur's Funsur tin smelter production is expected to reach 22,000 t of tin metal in 2000, compared with 18,000 t in 1999.

Russia.—The country's only tin smelter, the Novosibirsk Tin Combine, announced plans to increase output by more than 50% over that of 1999. The firm expected to produce 6,000 t of refined tin and 3,000 t of solder. It also plans to raise total annual output to 20,000 t in 2001, a level not achieved since 1986, to meet increased domestic demand. Novosibirsk plans to move ahead with the development of its resource base in 2001 by making acquisitions and increasing production of tin concentrate at the four mining complexes that it controls or partially owns. By yearend 2000, the four complexes in which Novosibirsk owns an interest were expected to achieve a production level that will cover at least 80% of the smelter's needs, with the Deputakskolovo Tin Mine providing one-half of the total. The firm started a long-term investment program at Deputakskolovo with a total cost of about \$5 million. The aim

is to increase mine output there by 30% to 40%. The mine is in far eastern Russia at Yakutia and is ice-bound for much of the year (Tin International, 2000d).

Slovakia.—Shareholders in the Slovak steel group, VSZ a.s., approved a plan which would allow U.S. Steel Group to acquire the company's core assets, including its tinplate operations. The deal would add about 3.4 Mt of crude steel production to U.S. Steel's existing 11 Mt. About 84% of VSZ's stockholders gave their support to the proposal as stated in a memorandum of understanding. Officials indicated that U.S. Steel had committed \$700 million in capital spending for the first phase of a VSZ modernization program. Initially, the company will complete the upgrade of its current 50-50 tinplate joint venture with VSZ by installing a 200,000-t/yr continuous annealing line. A \$26 million temper line will also be installed, followed by a new 200,000-t/yr tinning line. Upon completion of the acquisition, U.S. Steel would target sales primarily within Central and Eastern European markets. U.S. Steel officials believe that markets within 600 kilometers (km) of the Kosice plant location are sufficient to absorb expected mill capacity (Metal Bulletin, 2000g).

Thailand.—The Department of Mineral Resources reported that Thai tin-in-concentrate production increased 69% to 2,700 t in 1999 compared with 1,600 t in 1998. Officials attributed the rise mostly to the increased number of active mines in 1999 (30 compared with 23 mines in 1998). Thailand has only one tin smelter, Thaisarco, which has a maximum output capacity of 36,000 t/yr of refined tin metal. Thaisarco produced 17,000 t of tin metal in 1999, an 11% increase over the 15,000 t produced in 1998. Thailand's tin metal exports were 13,000 t in 1999, compared with 11,000 t in 1998. Domestic tin sales increased 20% in 1999 to 4,800 t (Platt's Metals Week, 2000f).

Turkey.—The country's only tinplate producer, Erdemir, announced that it had increased tinplate output at its Ereğli Works from 100,000 to 300,000 t/yr. The increase followed the recent addition of a new tinning line, an electrolytic cleaning line, and a shearing line (Metal Bulletin, 2000c).

United Kingdom.—A proposal was made to reopen the South Crofty Tin Mine by Baseresult plc, a local Cornwall firm. South Crofty was England's last operating tin mine when it closed in 1998. Baseresult was negotiating with South Crofty plc (the mine's owner) for the mine, land comprising the mine-site, and processing equipment from the Wheal Jane concentrator plant nearby. South Crofty's mining permit was extended to allow the negotiations to continue. Baseresult plans to produce 2,000 t/yr of tin-in-concentrate at an operating cost of \$2,800 per metric ton of tin, well below the current cost \$5,510 per metric ton. However, officials believe the mine can be profitable only if the company diversifies the operation to include other activities (such as waste management from energy facilities in the region). Nevertheless, officials expressed confidence that Baseresult can extend the life of the mine beyond the 7 years during which its plans to mine the upper levels of the deposit (Platt's Metals Week, 2000a).

In Yorkshire, Rio Tinto Ltd. announced that it expected to disprove in court allegations that its former Capper Pass Tin Smelter caused injuries or illnesses among workers and local residents. Rio Tinto's subsidiary, Capper Pass and Son Ltd., located in Hull, was the world's largest tin smelter at the time of its closure in 1991. Rio has repeatedly rejected allegations that

emissions from the smelter were responsible for medical problems among local residents and former employees, or that the emissions damaged the surrounding environment. No date has yet been set for a court hearing in the case (Metal Bulletin, 2000e).

Vietnam.—Tiberon Minerals Ltd. (Canada) announced that it had begun exploration work at a diverse metals deposit in the northern part of Vietnam. Along with tin, other discoveries at the Nui Phao site, about 80 km north of Hanoi, include bismuth, gold, and tungsten (CRU Tin Monitor, 2001).

Current Research and Technology

Crown, Cork and Seal Corp. (Philadelphia, PA), the world's largest packaging manufacturer, announced the development of a new beverage can end that offers reduced metal usage and easier opening. Crown believes the new style can end will afford substantial savings in material costs and can be applied equally to tinplate or aluminum ends. Currently, almost all beverage can ends in the United States are aluminum, but tinplate shares the remaining worldwide market (Canning and Filling, 2000).

Researchers at Leeds University in the United Kingdom announced the development of a new method of recycling steel, including steel tinplate, that reportedly is cheaper, requires no presorting of scrap, and may even produce a stronger material. All steel producers recycle a significant proportion of steel scrap. Tin from tinplate scrap and copper from domestic incinerator scrap accumulates in the steel, posing a major quality problem for the steel industry unless properly controlled. Such impurities in anything other than small amounts can have harmful effects on ductility, causing defects in the worked material. Unless removed or controlled by careful scrap selection, these impurities could rise to unacceptable levels over the next few years due to increased recycling targets. The Leeds team discovered that the controlled addition of aluminum to the molten steel during recycling forms alloys with the tin and/or copper rendering both harmless. The new steel alloy may even be improved by this patented process. Initial studies show that the presence of aluminum causes an increase in the hardness of the steel, implying an increase in mechanical strength. The source of aluminum can be pure metal, an alloy, or a compound capable of dissociation at the operating temperature. To the researchers, an obvious source would be aluminum cans, currently recycled separately from steel cans; they reason that the recycling industry ultimately could change and not separate steel and aluminum used cans, but instead charge mixed loads of scrap, thereby saving on sorting costs. The addition of a metal as an alloying agent is a radical departure from conventional treatments such as those used in detinning plants or plants to extract unwanted metals by chemical or electrochemical methods (Tin International, 2000f).

During Metal Bulletin's 6th International Tin Conference held in San Diego, CA, May 7-9, a researcher speaking for the International Tin Research Institute (ITRI) (Uxbridge, UK) focused on the potential market for tin usage in flame retardants. The speaker noted that among the current types of flame retardants, tin's best opportunity for market penetration are in fields currently served by antimony trioxide. In the late 1980s ITRI developed a zinc stannate compound as a fire

retardant. This compound shows excellent smoke suppressant characteristics compared with antimony trioxide, but it is much more costly. ITRI continues its work in this area. The speaker indicated that the potential world replacement market for antimony trioxide is 36,000 t, of which 5,000 t may be a realistic target for tin over the next 10 years.

Outlook

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

World tin reserves appear to be adequate to meet foreseeable demand. Secondary sources of tin are likely to remain an important component of tin supply, especially in the United States. The NDS sales are expected to continue in coming years and remain an important segment of domestic supply until the inventory is exhausted. Domestic tin needs, however, will probably continue to be met primarily through imports.

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TABLE 1
SALIENT TIN STATISTICS 1/

(Metric tons of contained tin, unless otherwise specified)

	1996	1997	1998	1999	2000
United States:					
Production, secondary e/	11,600	12,400	16,300	16,400 r/	15,100
Exports, refined tin	3,670	4,660	5,020	6,770	6,640
Imports for consumption, refined tin	30,200	40,600	44,000	47,500	44,900
Consumption:					
Primary	36,500	36,200	37,100	38,000 r/	38,100
Secondary	8,180	8,250	8,620	8,890	8,940
Stocks, yearend, U.S. industry	10,900	11,200	10,500	10,700	10,400
Prices, average:					
New York market cents per pound	288.10	264.45	261.38	254.54	254.92
Platt's Metals Week composite do.	412.43	381.49	373.26	365.98	370.16
London do.	279.00	256.00	251.00	245.00	246.00
Kuala Lumpur do.	275.19	252.24	246.06	240.70	244.12
World, production:					
Mine	220,000	217,000	207,000 r/	216,000 r/	238,000
Smelter:					
Primary	211,000	222,000 r/	226,000	236,000 r/	258,000 e/
Secondary	16,700	17,500	20,400	25,900	27,600 e/
Undifferentiated	200	200	200	100	--

e/ Estimated. r/ Revised. -- Zero.

1/ Data are rounded to no more than three significant digits.

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

(Metric tons of contained tin)

	1999	2000
Stocks, January 1, 2000 2/	9,290	8,910
Net receipts during year:		
Primary	40,500 r/	41,400
Secondary	2,790	2,990
Scrap	6,360 r/	6,080
Total receipts	49,700 r/	50,400
Total available	58,900 r/	59,300
Tin consumed in manufactured products:		
Primary	38,000 r/	38,100
Secondary	8,890	8,940
Total	46,900	47,000
Intercompany transactions in scrap	82 r/	85
Total processed	47,000 r/	47,100
Stocks, December 31, 2000 (total available less total processed)	11,900	12,300

r/ Revised.

1/ Data are rounded to no more than 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	1999			2000		
	Primary	Secondary	Total	Primary	Secondary	Total
Alloys (miscellaneous) 2/	W	W	W	W	W	W
Babbitt	1,450	156	1,610	1,510	152	1,660
Bar tin	721 r/	W	721 r/	714	W	714
Bronze and brass	1,450	1,960	3,410	1,450	1,900	3,360
Chemicals	8,220	W	8,220	8,040	W	8,040
Collapsible tubes and foil	23 r/	W	23 r/	W	W	W
Solder	12,800	5,960	18,700	12,700	6,130	18,800
Tinning	905 r/	W	905 r/	1,200	W	1,200

See footnotes at end of table.

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

(Metric tons of contained tin)

Product	1999			2000		
	Primary	Secondary	Total	Primary	Secondary	Total
Tinplate 3/	9,150	--	9,150	8,800	--	8,800
Tin powder	W	W	W	W	W	W
Type metal	W	W	W	W	W	W
White metal 4/	943 r/	W	943 r/	1,260	W	1,260
Other	2,390 r/	822	3,220 r/	2,390	754	3,140
Total	38,000 r/	8,890	46,900 r/	38,100	8,940	47,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other." -- Zero.

1/ Data are rounded to no more than 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)

	1999	2000
Plant raw materials:		
Pig tin:		
Virgin 2/	7,030 r/	6,940
Secondary	882	834
In process 3/	1,080 r/	1,060
Total	8,990 r/	8,830
Additional pig tin:		
Jobbers-importers	1,470	1,240
Afloat to United States	240	340
Total	1,710	1,580
Grand total	10,700	10,400

r/ Revised.

1/ Data are rounded to no more than 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
U.S. STOCKS, RECEIPTS, AND CONSUMPTION OF NEW AND OLD SCRAP AND TIN RECOVERED, BY TYPE OF SCRAP 1/

(Metric tons)

Type of scrap	Stocks, January 1	Receipts	Gross weight of scrap			Stocks, December 31	Tin recovered e/ 2/		
			New	Old	Total		New	Old	Total
1999:									
Copper-base scrap	6,350	124,000	28,000	96,000	124,000	6,450 r/	1,230	3,620	4,860
Brass mills 3/	--	57,600	57,600	--	57,600	--	947	--	947
Foundries and other plants	2,270 r/	17,800 r/	5,970	12,000 r/	18,000 r/	2,110 r/	282	426 r/	708 r/
Total	XX	XX	XX	XX	XX	XX	2,460	4,050 r/	6,510 r/
Lead-base scrap	25,400	1,310,000	61,200	1,250,000	1,310,000	22,000 r/	1,610	3,670	5,280
Tin-base scrap 4/	W	W	W	W	W	W	4,580	W	4,580
Grand total r/	XX	XX	XX	XX	XX	XX	8,650	7,720 r/	16,400 r/
2000:									
Copper-base scrap	6,450	141,000	57,700	82,600	140,000	6,170	1,160	3,120	4,270
Brass mills 3/	--	123,000	123,000	--	123,000	--	1,650	--	1,650
Foundries and other plants	2,110	17,400	W	W	17,800	1,690	W	425	425
Total	XX	XX	XX	XX	XX	XX	2,800	3,540	6,340
Lead-base scrap	22,000	1,010,000	50,700	958,000	1,010,000	19,400	1,330	3,060	4,390
Tin-base scrap 4/	W	W	W	W	W	W	4,320	W	4,320
Grand total	XX	XX	XX	XX	XX	XX	8,450	6,600	15,100

See footnotes at end of table.

TABLE 5--Continued
U.S. STOCKS, RECEIPTS, AND CONSUMPTION OF NEW AND OLD SCRAP AND TIN RECOVERED, BY TYPE OF SCRAP 1/

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data. XX Not applicable. -- Zero.

1/ Data are rounded to no more than 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 to be equal to receipts; the line, therefore, does not balance.

4/ Includes tinplate and other scrap recovered at detinning plants.

TABLE 6
U.S. EXPORTS OF TIN IN VARIOUS FORMS 1/

Year	Tinplate and terneplate		Ingots and pigs		Tin scrap and other tin-bearing material except tinplate scrap 2/	
	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
1999	290,000	\$172,000	6,770	\$38,100	33,200	\$56,100
2000	300,000	163,000	6,640	35,300	26,200	48,800

1/ Data are rounded to no more than three significant digits.

2/ Includes rods, profiles, wire, powders, flakes, tubes, and pipes.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF TIN IN VARIOUS FORMS 1/

Year	Miscellaneous 2/ value (thousands)	Dross, skimmings, scrap, residues, tin alloys, n.s.p.f.		Tinplate and terneplate		Tin compounds		Tinplate scrap	
		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)
1999	\$4,830	3,870	\$7,840	449,000	\$255,000	411	\$3,550	58,000	\$5,270
2000	5,680	5,170	17,700	359,000	206,000	586	4,740	14,500	1,660

1/ Data are rounded to no more than three significant digits.

2/ Includes tinfoil, tin powder, flitters, metallics, manufactures, n.s.p.f.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF UNWROUGHT TIN METAL, BY COUNTRY 1/

Country	1999		2000	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Australia	258	\$1,250	317	\$1,600
Belgium	182	1,110	74	502
Bolivia	3,850	20,800	6,330	35,600
Brazil	4,700	25,800	5,860	31,500
Canada	72	451	10	64
Chile	3,980	21,100	2,630	14,700
China	13,900	71,800	10,200	55,900
Hong Kong	261	3,360	397	2,330
Indonesia	7,930	42,200	5,320	29,100
Malaysia	944	5,200	214	1,180
Netherlands	19	2,110	--	--
Peru	11,000	58,100	12,800	69,200
Singapore	60	306	20	114
Thailand	20	101	--	--
United Kingdom	60	352	514	1,310
Other	284	1,440	178	968
Total	47,500	255,000	44,900	244,000

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 9
TIN: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1996	1997	1998	1999	2000 e/
Australia	8,828	10,169	10,204	10,038	9,146 3/
Bolivia	14,802	12,898	11,308	12,417 r/	12,464 3/
Brazil	19,617	19,065	14,607	13,200	13,000
Burma 4/	459	335	221	149	220
Burundi e/	25 3/	(5/)	23	10	10
Cameroon e/	1	1	1	1	1
China e/	69,600	67,500	70,100	80,100 r/	97,000
Congo (Kinshasa)	--	--	--	50 e/	50
Indonesia	52,304	55,175	53,959	47,754	48,000
Laos	1,056 r/	717 r/	627 r/	492 r/	600
Malaysia	5,174 r/	5,065	5,754 r/	7,340	6,307 3/
Mexico	2	5	5	4 r/	5
Mongolia	18	10	40	--	--
Niger e/	10	10	10	20	20
Nigeria e/ 6/	139 3/	150	200	200	300
Peru	27,004	27,952	25,747	30,403	37,410 p/
Portugal	4,637	2,667	3,100 r/	2,200 r/	1,200
Russia e/	8,000	7,500	4,500	4,500	5,000
Rwanda	260 r/	258 r/	260 r/	243 r/	344 3/
Spain e/	2	2	2	2	3
Thailand	1,300 r/	746 r/	1,656 r/	2,712 r/	1,930 3/
Uganda	(5/)	2 r/	1 r/	-- r/	-- 3/
United Kingdom	2,103	2,396	376	--	--
Vietnam e/	4,500	4,800 r/	4,500	4,500 r/	4,500
Zimbabwe e/	10 3/	10	1	1	1
Total	220,000	217,000	207,000 r/	216,000 r/	238,000

e/ Estimated. p/ Preliminary. r/ Revised. -- Zero.

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

2/ Table includes data available through July 4, 2001.

3/ Reported figure.

4/ Includes content of tin tungsten concentrate.

5/ Less than 1/2 unit.

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

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

(Metric tons)

Country	1996	1997	1998	1999	2000 e/
Argentina, primary e/	-- r/	-- r/	-- r/	-- r/	--
Australia:					
Primary	460	605	655	585	775 3/
Secondary e/	300	300	300	300	300
Total e/	760	905	955	885	1,080
Belgium, secondary e/	3,000	3,000	2,500	8,100 r/	8,500
Bolivia, primary	16,733	16,853	11,102	11,166 r/	9,353 3/
Brazil:					
Primary	18,361	17,525	17,500 e/	13,200	13,000 3/
Secondary e/	250	250	250	250	250
Total e/	18,600	17,800	17,800	13,500	13,300
Bulgaria, secondary	8	10	10 e/	10 e/	10
Burma, primary	310 r/	228 r/	31 r/	32 r/	30
China, primary e/	71,500	67,700	79,300	90,800 r/	111,000
Czech Republic, secondary e/	100	100	100	100	100
Denmark, secondary e/	100	100	100	100	100
Germany, primary and secondary e/	100	100	100	--	--
Greece, secondary e/	100	150	200	200	150
Indonesia, primary	39,000 e/	52,658	53,401	49,105	50,000
Japan, primary	524	507	500	568 r/	593 3/
Malaysia, primary	38,051	34,822 r/	27,201 r/	28,913 r/	27,200
Mexico, primary	1,234	1,188	1,078 r/	1,258 r/	1,300

See footnotes at end of table.

TABLE 10--Continued
TIN: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1996	1997	1998	1999	2000 e/
Nigeria, primary	100	100 e/	150	50 e/	100
Norway, secondary e/	50	50	50	50	50
Peru, primary	2,370	8,999	14,363	16,960	20,000
Portugal, primary and secondary e/	100	100	100	100	--
Russia: e/					
Primary	9,000	6,700	3,000	3,400 r/	4,700
Secondary	1,000	1,000	500	400 r/	500
Total	10,000	7,700	3,500	3,800 r/	5,200
Spain: e/					
Primary	150	150	100	50	--
Secondary	50	50	50	50	25
Total	200	200	150	100	25
Thailand, primary	10,981	11,986	15,353	17,306	17,076 3/
United Kingdom, secondary e/	100	100	50	--	--
United States, secondary	11,600	12,400	16,300	16,400 r/	15,100
Vietnam, primary	2,300	2,400	2,400 e/	2,400	2,400 3/
Grand total	228,000	240,000 r/	247,000 r/	262,000 r/	283,000 3/
Of which:					
Total primary	211,000	222,000 r/	226,000	236,000 r/	258,000
Total secondary	16,700	17,500	20,400	25,900	25,000
Total undifferentiated	200	200	200	100	--

e/ Estimated. r/ Revised. -- Zero.

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

2/ Whenever possible, total 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 4, 2001.

3/ Reported figure.