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INDIUM

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INDIUM

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All refined indium produced in the United States during 2007 came from the refining of lower grade imported indium metal and from refining of scrap. Two refineries, one in New York and the other in Rhode Island, produced the majority of indium metal and indium compounds in 2007. A number of small companies produced specialty indium alloys and other indium products.

In 2007, domestic consumption of indium was estimated by the U.S. Geological Survey to have remained level at 125 metric tons (t). The value of indium consumed in the United States was about $80 million at an average New York dealer price of $637 per kilogram, as calculated from weekly price ranges published in Platts Metals Week.

World primary production in 2007 decreased compared with that of 2006, owing to decreased output in China. China accounted for about 60% of world production, roughly the same percentage as in 2006. Other major producing countries of refined indium recovered from domestic or imported concentrates or residues were Canada, Japan, and the Republic of Korea (table 2).

Global indium consumption was thought to have increased in 2007 owing to a continued strong demand for indium tin oxide (ITO) coatings used in the manufacturing of flat-panel displays for consumer electronic devices including computer monitors, mobile telephones, televisions, as well as growth in other ITO-containing technologies.

Production

Though zinc was mined domestically, primary indium apparently was not recovered as a byproduct in the United States. Production of indium consisted of upgrading imported indium metal and powder. Lower grade (99.97%) and standard-grade (99.99%) imported indium was refined to purities of up to 99.99999%. Indium Corporation of America, Utica, NY, and Umicore Indium Products, Providence, RI (a division of n.v. Umicore, s.a., Olen, Belgium), accounted for the major share of U.S. production of indium metal and products. Indium metal was sold in various forms (foil, ingot, powder, ribbon, wire, and others) and grades. Many small companies produced high-purity indium alloys, compounds, solders, ITO coatings, and other indium products.

Recycling

A large portion of global secondary indium was produced from ITO recycling. Sputtering, the process in which ITO is deposited as a thin-film coating onto a substrate, is highly inefficient, as approximately 30% of an ITO target is deposited onto the substrate. The remaining 70% resides in the spent ITO target, the grinding sludge, and the after-processing residue left on the walls of the sputtering chamber. It was estimated that 60% to 65% of the indium in a new ITO target will be recovered, and research was underway to improve this rate further. A short recycling process time for used ITO targets is critical as a recycler may have millions of dollars worth of indium in the recycling loop at any one time, and a large increase in ITO scrap could be problematic owing to large capital costs, environmental restrictions, and a lack of storage space. It was reported that the ITO recycling process—from collection of scrap to production of secondary materials—now takes less than 30 days. Spent ITO target recycling was concentrated in China, Japan, and the Republic of Korea—the countries where ITO production and sputtering take place. Global ITO recycling capacity was estimated by one source to be about 400 metric tons per year (t/yr), with more than 200 t/yr of additional capacity under development in China (120 t/yr), Japan (100 t/yr), and the Republic of Korea (25 t/yr) (Phipps and others, 2007; Stevens, 2007, p. 1-16).

A liquid crystal display (LCD) manufacturer has developed a process to reclaim indium directly from old LCD panels. The panels are crushed to millimeter-sized particles and then soaked in an acid solution to dissolve the ITO from which the indium is recovered.

Indium recovery from tailings was thought to have been insignificant, as these wastes contain low amounts of the metal and can be difficult to process. However, recent improvements to the process technology have made indium recovery from tailings viable when the price of indium is high.

Consumption

Indium Tin Oxide.—Production of ITO was the leading end use of indium, accounting for more than three quarters of global indium consumption. ITO is used for electrically conductive purposes in a variety of flat-panel display devices—most commonly, LCDs. Leading ITO manufacturers included Mitsui Mining & Smelting Co., Ltd. (Tokyo, Japan), Nikko Materials Co., Ltd. (Tokyo), Samsung Corning Co., Ltd. (Suwon, Republic of Korea), and Tosoh Corporation (Tokyo). About 80% of ITO target production took place in Japan. Significant amounts of ITO were also produced in China, the Republic of Korea, and Taiwan. Japanese ITO manufacturers planned to reduce their indium supply from China during 2008 owing to the recently introduced Chinese export quota system (Watanabe, 2007c, e).

Sources reported that the anticipated surge for flat-panel televisions failed to materialize causing ITO producers to consume less indium than anticipated towards the end of 2007. However, Japanese ITO manufactures expected that their ITO production would increase in 2008 compared with that of 2007, as demand for the material was projected to increase by 10% to 15% alongside rising flat-panel shipments. Touch screens for mobile devices were also another growing application for ITO. Mobile telephones with a multi-touch LCD screen have two layers of ITO, doubling the amount of indium traditionally used in the screen. One source reported that demand for ITO in Asia was 910 t in 2007. Breakdown was as follows—Republic of Korea, 320 t; Taiwan, 300 t; Japan, 250 t; and China, 40 t (Platts Metals Week, 2007e; Roskill's Letters from Japan, 2007; Wang and Lam, 2007; Watanabe, 2007d; Metal Bulletin Monthly, 2008).

Alloys and Solders.—Alloys and solders were the second leading end use of indium. Indium-containing solders have lower crack propagation and improved resistance to thermal fatigue when compared to tin lead solders. They also inhibit the leaching of gold components in electronic apparatus. Low-melting-point indium alloys are used as fuses and temperature indicators. In the optical industry, low-melting-point alloys are applied to lenses and act as a surface for machine tools to grip during the polishing process. Certain types of indium alloys can also be used as a bonding agent between nonmetallic materials, such as glass, glazed ceramics, and quartz. Indium has also been used in dental alloys and in white gold alloys.

Other.—Other uses of indium included electrode-less lamps, mercury alloy replacements, and nuclear control rods. Alkaline batteries use indium to prevent buildup of hydrogen gas within sealed battery casings.

Indium was also used in semiconducting applications, including light-emitting diodes for fiber-optic communications. Indium phosphide was being used in experimental computer chips that could transfer data at rapid speeds. In March, researchers from IBM Corp. (Anaheim, CA) revealed an optical transceiver chipset that used indium phosphide and gallium arsenide to transfer data via light pulses, allowing for greater bandwidth and higher speeds in connectivity. The optical chipset could transfer as much as 160 gigabits of information in one second; currently, data transfer occurs through copper wires at rates of 2.5 to 5 gigabytes per second (IBM Corp, 2007; Malykhina and Gonsalves, 2007).

Photovoltaic (PV) applications could become another large market opportunity for indium. Thin-film PV technologies—including cadmium telluride and copper indium gallium diselenide (CIGS)—accounted for less than 6% of the global solar market. Silicon-based technologies continued to dominate at a 94% share. However, a shortage of high-purity polysilicon prompted the development of thin-film PV technology, which is less efficient but more economical than the silicon-based counterparts. Flexible CIGS solar cells could be used in roofing materials and in various applications in the aerospace, military, and recreational industries. Global Solar Energy, Inc. (Tucson, AZ) announced plans to increase its CIGS PV production capacity from 5 to 60 megawatts per year (MW/yr) at its factories located in Tucson, AZ, and Berlin, Germany, by installing equipment that utilized a continuous roll to roll deposition process. HelioVolt Corp. (Austin, TX) planned to construct a facility in Austin to manufacture CIGS thin-film solar energy products using a process based on rapid semiconductor printing. The facility would begin production in 2008 with an initial production capacity of 20 MW/yr (HelioVolt Corp., 2007; Wiedeman and others, 2007).

Foreign Trade

During 2007, U.S. imports for consumption of unwrought indium and indium powders totaled 147 t, an increase of 46% from the 100 t imported in 2006. Leading suppliers included China (44%), Canada (23%), and Japan (17%) (table 1). There was no exclusive domestic export classification code for unwrought indium and indium powders.

Prices

Platts Metals Week publishes a weekly New York dealer price range for indium [99.99% minimum purity; at warehouse (Rotterdam); cost, insurance, and freight; and in minimum lots of 50 kilograms]. Indium prices began the year ranging from $650 to $710 per kilogram. After rising during January, the price range remained at $680 to $730 per kilogram from early February through mid-April and then declined until yearend. From late November to yearend, prices ranged from $470 to $540 per kilogram. The 2007 average annual New York dealer price range was $612 to $663 per kilogram.

According to Platts Metals Week, the Indium Corp. of America producer price for indium (99.97% purity, 1-kilogram bar in lots of 10,000 troy ounces, free on board) began the year at $835 per kilogram, then decreased to $685 in late September and remained at that level for the rest of the year. The 2007 annual average U.S. producer price (Indium Corp.) was $795 per kilogram.

Indium prices hit a 3-year low in 2007. Low prices were attributed to increased indium production by Japanese ITO recyclers, which was keeping buyers off the market for primary metal (Abrams, 2007a-b; Teo, 2007c).

World Review

Argentina.—Silver Standard Resources, Inc. (Vancouver, British Columbia, Canada) announced that production at the Pirquitas silver project in Jujuy would begin towards the end of 2008. The mine would produce gallium, 13 t/yr of indium, 10.9 million ounces per year of silver, 2,500 t/yr of tin, and 6,500 t/yr of zinc during 14.5 years. The company did not specify where Pirquitas' concentrates would be sent for processing (Harris, 2007a).

In late December, Argentex Mining Corp. (Vancouver) began a drilling program to define the mineral resources at the Pinguino property located in Santa Cruz. Earlier drill testing at Pinguino verified the presence of a significant zinc-lead-indium-silver-copper-gold mineralization on the property (Argentex Mining Corp., 2007).

Marifil Mines Ltd. (Vancouver) continued its drilling program at the San Roque Project located in Rio Negro. The company intercepted high-grade indium along with considerable amounts of lead, gold, silver, and zinc within the Del Indio breccia located on the property (Marifil Mines Ltd., 2007).

Australia.—Reportedly, Nyrstar NV (Balen, Belgium) considered recovering indium at its lead and zinc smelting operations at Port Pirie, South Australia (Kassakovich, 2007).

North Queensland Metals, Ltd. (Fortitude Valley, Queensland) continued its feasibility study of the Baal Gammon copper-silver-tin-indium project. The mine would yield 20,000 t/yr of concentrate during a 6-year mine life. Probable reserves at Baal Gammon were contained in 3.1 million metric tons (Mt) of resources grading 29.6 grams per metric ton of indium. The company planned to process the concentrates in Australia at a plant that could produce separate indium-tin and copper products (North Queensland Metals, Ltd., 2008, p. 9).

Belgium.—Indium metal (foil and ingots) was produced at Umicore's precious metals refinery at Hoboken. A special metals plant at the refinery recovered indium from dusts and residues generated by the facility's lead refinery. Production capacity was 30 t/yr of indium.

Bolivia.—Several mines in Bolivia produced indium-bearing concentrates, which were exported and processed elsewhere. The Vinto tin smelter and refinery complex in Oruro considered expanding production to include additional byproducts, including indium metal. The state-owned Huanuni tin mine supplied 60% to 80% of Vinto's concentrates. Vinto was formerly owned by Glencore International AG (Baar, Switzerland) and was renationalized under the Ministry of Mining and Metallurgy in February (Harris, 2007b).

Dowa Metals and Mining Co., Ltd. (Tokyo) announced that it was actively exploring for indium-rich zinc deposits in South America, particularly Bolivia. The company stressed that it was still in the early stages of exploration and currently had no viable deposits to develop (Metal Bulletin, 2007).

In April, South American Silver Corp. (Vancouver) completed the purchase of the Malku Kohota silver-gold property in Potosi in 2007. Mineralized zones on the property consist of disseminated silver associated with indium. Indicated resources at the deposit measured 845 t of indium (South American Silver Corp., 2008).

Brazil.—Votorantim Metais (a unit of Grupo Votorantim, Sao Paulo) announced plans to start producing indium metal at its refinery in Juiz de Fora as part of its Polymetallic Project. The two-stage project entailed expanding the existing zinc refinery to produce additional metals and products. The first stage, scheduled for completion in 2008 to 2009, included the construction of a 15-t/yr indium plant and increasing its existing zinc production. During the second phase, a facility would be built that would produce gold-silver alloy, lead metal, polypropylene, and sulfuric acid from lead concentrates and recycled automotive batteries and other lead-bearing scrap (Australia-Latin America Business Council, 2006, p. 13; Votorantim Metais, 2007).

In May, Crusader Holdings NL (West Perth, Western Australia, Australia) acquired exploration rights over the Manga tin-indium project in Goias State in central Brazil. Assay results from rock samples collected at the site showed a mineralization grading up to 5% tin and 127 parts per million of indium. The company planned to begin a drilling program at Manga in early 2008 (Crusader Holdings NL, 2008).

Canada.—Refined indium was produced at Teck Cominco Ltd.'s (Vancouver) lead-zinc metallurgical complex at Trail, British Columbia, and Xstrata plc's (Zug, Switzerland) Kidd Creek copper-zinc metallurgical operations at Timmins, Ontario.

Teck Cominco set a refined indium production record in 2007 at Trail, surpassing the previous record of 51.5 t set in 2006. The amount, however, was not published. Indium production had previously been limited by high levels of tin in the imported indium-bearing concentrates. In 2006, the company commissioned a tin removal circuit at the drossing plant, expanding the facility's indium production capacity to more than 75 t/yr. Actual production would be limited by the availability of indium-bearing concentrates (Teck Cominco Ltd., 2006, p. 27; 2008, p. 32).

In 2007, Xstrata produced 11 t of refined indium at Kidd Creek. The facility consisted of a copper refinery and smelter, an integrated zinc roaster and refinery, a cadmium plant, an indium plant, and two sulfuric acid plants (Xstrata Copper Canada, 2008, p. 2).

Adex Mining Inc. (Toronto, Ontario) planned to begin a drill program at its Mount Pleasant property in southwestern New Brunswick. The property was the site of the former Mount Pleasant tungsten mine, which operated from 1983 until 1985 when it closed owing to low tungsten prices. The site contains ore zones with tungsten-molybdenum mineralization and indium-tin mineralization. Adex planned to develop the tungsten-molybdenum deposits before potentially developing the indium-tin ore bodies.

China.—The Government imposed an export license system on January 1 for minor metals—including indium metal, powders, products, and scrap—to control exports of products considered pollution- and resource-intensive. On March 9, the Ministry of Commerce announced the export license requirements for indium producers and traders. The criteria stated that export quotas would be granted to qualified smelters that produced more than 4 t/yr of indium metal, chemical producers that produced more than 10 t/yr, and independent recycling mills that produced more than 15 t/yr. Trading houses must have a registered capital of 70 million yuan in order to qualify for an export license. Both producers and traders must have had a checkable export history of at least 3 years. In reaction to the policy, several small-scale indium producers petitioned the export license and quota system arguing that it would likely drive many of them out of business and give market control to a few large, state-owned operations. Traders discussed forming an export cooperative in order to qualify; many trading houses in China were capitalized at less than 70 million yuan (American Metal Market, 2007; Teo, 2007b; Watanabe, 2007a).

The new quota system took effect on June 18. The following 17 producers were granted indium export permits: Guangxi Intai Technology Co., Ltd.; Hsikwangshan Twinkling Star Antimony Co., Ltd.; Huludao Nonferrous Metals Group Co., Ltd., Imp. & Exp. Branch; Hunan Jingshi Group Co., Ltd.; Jiangsu Sainty Corp., Ltd.; Laibin Debang Industry and Trade Co., Ltd.; Liuzhou China Tin Group Co., Ltd.; Liuzhou Silver Materials Co., Ltd.; Liuzhou Yinggeer Nonferrous Metals Co., Ltd.; Nanjing Germanium Co., Ltd.; Nanjing Kinyu Electronic Materials Co., Ltd.; Shenzhen Zhongjin Lingnan Nonfemet Co., Ltd.; Shuikoushan Nonferrous Metals Co., Ltd.; Xiangtan Zhengtan Nonferrous Metals Co., Ltd.; Yunnan Chengfeng Nonferrous Metals Co., Ltd.; Zhuzhou Keneng New Material Co., Ltd.; and Zhuzhou Smelter Group Co., Ltd. The two licensed traders were China Minmetals Nonferrous Metals Co. and Nanjing Foreign Economic & Trade Development Co., Ltd. The indium export quota was set to 240 t in 2008 and 233 t in 2009. It was speculated that the quota system would not likely affect the global supply of indium; the final list of permitted exporters was reported to be the same as the list of applicants, and the assigned export quotas for the producers most likely reflected their production capacity (Platts Metals Week, 2007b; China Metal Market, 2008).

On May 9, China opened the world's first indium exchange in Liuzhou, Guangxi Province. The Guangxi Yingu Nonferrous Metals Exchange Center would serve as the trading platform for six major indium producers in Guangxi. The exchange was established to protect the country's indium reserves and to regulate prices. Specifications were for indium of 99.99% purity in lots of 100 kilograms. Trading was slow to start on the Guangxi Yingu Exchange; reportedly, offer prices on the exchange were higher than the average market prices. Some doubts were raised as to whether the Guangxi Yingu should be considered an exchange since its Web site listed only the producer prices and not the transaction prices (Teo, 2007a; Watanabe, 2007b).

Production.—China was a major global producer of indium. Many primary producers were located in the indium-bearing regions of Guangxi and Yunnan Provinces. According to one source, domestic indium production in 2007 was expected to decrease 50% from that of 2006. Lower production was attributed to stricter environmental standards and the export quota system. After the quota system was implemented, only 5 of the 30 indium-producing facilities in Yunnan continued to operate. In Guangxi, a few large-scale indium producers failed to operate at full capacity, and many small- and mid-sized operations closed (China Metal Market, 2007a).

Liuzhou China Tin stopped exporting indium towards the latter half of 2007 owing to low prices; the production cost of 99.99%-pure indium metal in China was estimated to be between $550 to $650 per kilogram. Liuzhou China Tin was reportedly China's leading exporter of indium with a quota of 23 t in 2007. The company's indium production capacity reportedly was between 30 and 40 t/yr (Watanabe, 2007c).

Unionmet (Singapore) Ltd. planned to increase its indium production capacity to 35 t/yr from 25 t/yr through equipment upgrades and the construction of an additional coarse indium production facility. Additional raw materials would be secured from suppliers in the Fujian, Guangxi, Hunan, Inner Mongolia, Qinghai, and Yunnan Provinces. Unionmet processed zinc concentrate with an indium content of up to 0.1% through its wholly owned subsidiary (Liuzhou UnionZinc Industry Co., Ltd.) to produce zinc byproducts and indium slag and strip liquor. The zinc byproducts were sold, and the indium slag and strip liquor was processed into indium metal by its other subsidiary, Guangxi Intai Technology [Unionmet (Singapore) Ltd., 2007].

The Honghe Hani and Yi Autonomous Prefecture in Yunnan Province planned to increase indium output within the region to 100 t/yr. There was a 50-t/yr indium smelting and processing plant in Honghe that was established in May 2005 by Yunnan Mengzi Metallurgy Co., Ltd. and Central South University (China Metal Market, 2007b).

Consumption.—Chinese consumption of indium was thought to be increasing, especially for the production of lower grade ITO targets; applications for such targets exclude sophisticated flat-panel technology, but include certain types of touch-screen displays (Ryan's Notes, 2007).

France.—Nyrstar's Auby zinc smelter recovered 15.9 t of indium in concentrate in 2007. The company commissioned an indium recovery circuit in late 2006 that produced a concentrate grading 20% indium, which was sold to third parties for further processing. A capacity expansion to 56 t/yr from 35 t/yr of indium concentrate was expected to be completed by the end of 2008 (Nyrstar NV, 2008, p. 20, 26).

Germany.—Indium was produced at PPM Pure Metals GmbH (Langelsheim) and Norddeutsche Affinerie AG (Hamburg). PPM recovered indium from indium-containing materials at its special metals production facility in Langelsheim. The company produced high-purity indium ingot, semifinished products, and indium compounds. Norddeutsche Affinerie AG also produced high-purity indium, which it consumed for the development of solar cells.

Japan.—The Ministry of Economy, Trade, and Industry (METI) launched a 5-year initiative (April 2007-March 2012) to find substitutes for dysprosium (in computer magnets), ITO, and tungsten (in machine tools). The Government was ultimately looking to advance technology that would reduce the domestic need for these materials and metals by about 70%. METI planned to begin working with private companies as early as July and hoped to develop practical substitutes by the end of the 5-year period. The Ministry requested $47 million (5.5 billion yen) to support the initiative, which was open to foreign companies for bidding if they collaborated with a Japanese organization. Magnetic material manufacturers, nonferrous metal companies, and universities were encouraged to participate (Metal-Pages, 2007c).

Production.—Asahi Pretec Corp. (Tokyo) commenced a new 100-t/yr indium recycling line on October 1, doubling secondary production capacity at its indium recycling plant in Fukuoka Prefecture to 200 t/yr from 100 t/yr (Platts Metals Week, 2007d).

Dowa Metals and Mining expected its primary and secondary indium production capacity to increase by March 2008 after expansion work was completed at its Akita Rare Metals facilities. Capacity at the primary production plant would increase to 100 t/yr from 80 t/yr; at the secondary production plant, to 200 t/yr from 150 t/yr. Akita Rare Metals has been recovering indium from scrap ITO targets since April 2003 (Platts Metals Week, 2007c).

Mitsubishi Materials Group intended to expand its ITO recycling capacity at its Onahama plant to 96 t/yr from 48 t/yr. The company invested 2 billion yen in the project and hoped to have the operation producing at full scale by December (Metal-Pages, 2007e).

Nippon Mining & Metals Co., Ltd. (Tokyo) planned to build an $83 million recycling facility in Hitachi, Ibaraki Prefecture, to recover indium, nickel, tin, and other metals from automotive and electronic scrap collected from nearby Tokyo. An intermediate copper material produced at the company's Saganoseki copper smelter would also be sent to the facility to recover antimony and copper. The indium recovery plant at the complex was to be completed in July 2008, and commercial production was to begin in 2009. Indium capacity would be 6 t/yr (Metal-Pages, 2007f).

Korea, Republic of.—The Republic of Korea intended to invest $5.6 billion in the exploration and development of foreign resources in order to control 40% of its mineral supply needs by 2020. This was in addition to an announcement made in 2006 that the country planned to build its resources of 13 metals—one of which was indium—to protect industry against supply disruptions. State-owned Korea Resources Corp. would manage all resource purchases. One source reported that the Republic of Korea imported 87% of the minerals it consumes (Kho, 2007).

Korea Zinc Co., Ltd. doubled its indium production in 2007 owing to additional output from its new indium recycling facility in Onsan, which was commissioned around mid-2006. Secondary production capacity at the plant was 100 t/yr of indium. Feedstock was sourced from Japanese ITO producers. The company also has the capacity to produce 100-t/yr of primary indium (Platts Metals Week, 2007f).

Peru.—Refined indium was produced at Doe Run Peru's La Oroya metallurgical complex and Votorantim Metais' Cajamarquilla zinc refinery. Doe Run reportedly planned to increase La Oroya's output of minor metals including antimony, bismuth, cadmium, indium, selenium, and tellurium (Metal-Pages, 2007d).

Votorantim Metais planned to invest $500 million to expand production at the Cajamarquilla zinc refinery by 2009 to increase its production of indium. A company spokesperson giving details on the Cajamarquilla expansion project mentioned that Votorantim would be producing indium at a rate of 38 t/yr, although it was not clear whether that rate would also include output from its indium production project currently under development in Brazil (Metal-Pages, 2007a).

Russia.—Chelyabinsk Zinc Plant OJSC and Ural Mining and Metals Co. (UMMC) produced refined indium in Russia. An additional indium production facility was reported to have opened near Moscow, as well. Almost all indium produced in Russia was thought to have been sold in Europe (Platts Metals Week, 2007a).

In 2007, Chelyabinsk produced 2.8 t of indium. The company produced indium as a byproduct of zinc processing, and production capacity at the facility was reported to be 10 t/yr. In February, Chelyabinsk received a U.S. patent for its indium powder production method, which results in a grain size of less than 15 micrometers. The powder would be used for defense purposes. The Russian mining company Dalpolimetall JSC supplied a portion of Chelyabinsk's indium-bearing zinc concentrate feedstock during 2007. Dalpolimetall operated several lead and zinc mines with significant amounts of indium in Russia's Far East, and began supplying Chelyabinsk with concentrate in 2006. However, Dalpolimetall's concentrate sales within Russia were thought to be limited by high transport costs (Metal-Pages, 2007g; Shaw, 2007).

UMMC's Electrozinc smelter had the capacity to produce between 6 t/yr and 8 t/yr of indium, with actual output typically ranging between 5 t/yr and 6 t/yr. UMMC recovered indium concentrate and metal from lead waste and from the large stockpiles of lead dust at the facility, which exceeded 10,000 t in weight with a concentration of 1.3 kilograms of indium per metric ton (Metal-Pages, 2007b, g).

Taiwan.—Samsung Corning planned to construct an ITO production facility in Taiwan. The company reportedly was planning to gain a larger share of the ITO market in Taiwan, an area where a significant amount of LCD panel manufacturing takes place (IRG Limited, 2007, p. 9).

Outlook

Both production and consumption of indium were expected to increase in 2008. However, without definitive consumption data, it is difficult to forecast whether the market will be in a surplus or deficit and to what degree. Several reports have indicated that demand for indium will outpace supply during the next few years. ITO production will probably increase as the LCD and flat-panel display markets continue to grow. The solar cell industry is experiencing growth, and the percentage of indium consumed for this market may increase substantially in the future.

On the supply side, a critical element will be the ability of individual countries to recycle indium-containing electronic components and scrap. Because primary indium is produced as a byproduct at a limited number of nonferrous smelting operations, it is difficult for supply to quickly respond to demand.

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TABLE 1
U.S. IMPORTS FOR CONSUMPTION OF UNWROUGHT INDIUM METAL, BY COUNTRY[1]

	2006		2007	
Country	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Belgium	7,900	$6,470	10,500	$6,860
Canada	22,100	15,500	33,300	15,900
China	38,400	28,500	64,000	14,400
Costa Rica	6	14	--	--
France	9	2	6	10
Germany	234	156	1,640	488
Hong Kong	3,720	2,170	5,710	2,490
India	3	6	--	--
Italy	82	88	--	--
Japan	18,000	12,400	24,700	12,200
Kazakhstan	--	--	2,140	1,410
Liechtenstein	--	--	110	40
Netherlands	223	132	322	171
Peru	4,270	3,320	1,520	873
Philippines	1,400	400	--	--
Russia	872	717	--	--
Singapore	1,210	835	1	4
Switzerland	--	--	145	15
Taiwan	--	--	380	95
United Kingdom	1,960	632	2,170	1,460
Total	100,000	71,400	147,000	56,400

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

Source: U.S. Census Bureau.

TABLE 2

INDIUM: ESTIMATED WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country	2003	2004	2005	2006	2007
Belgium	30	30	30	30	30
Canada	50	50	50	50	50
China	180	200	300	350	320
France	-- r	-- r	-- r	-- r	--
Germany[3]	10 r	10 r	10 r	10 r	10
Italy	5	5	5	5	5
Japan	70	70	70	55	60
Kazakhstan[4]	-- r	-- r	-- r	-- r	--
Korea, Republic of	--	--	--	50	50
Netherlands	5	5	5	5	5
Peru	6	6	6	6	6
Russia	10 r	11 r	12 r	12 r	12
Ukraine[4]	-- r	-- r	-- r	-- r	--
United Kingdom	5	5	5	5	5
Total	371 r	392 r	493 r	578 r	553

[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 August 8, 2008.

[3]Production of indium reinstated, because PPM Pure Metals GmbH (PPM) and Norddeutsche Affinerie AG (NA) reported that they were producing indium in 2007. NA is reportedly using its own indium in designing new solar cell technologies, but no estimates of indium production were actually available. This data represents only estimated production by PPM at the company's Langelsheim special metals plant.

[4]Kazakhstan and Ukraine may produce indium, but adequate information is unavailable to make reliable estimates of output levels.