INDIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: Indium was not recovered from ores in the United States in 2012. Two companies, one in New York and the other in Rhode Island, produced indium metal and indium products by upgrading lower grade imported indium metal. High-purity indium shapes, alloys, and compounds were also produced from imported indium by several additional firms. Production of indium tin oxide (ITO) continued to be the leading end use of indium and accounted for most global indium consumption. ITO thin-film coatings were primarily used for electrically conductive purposes in a variety of flat-panel devices—most commonly liquid crystal displays (LCDs). Other end uses included solders and alloys, compounds, electrical components and semiconductors, and research. The estimated value of primary indium metal consumed in 2012, based on the annual average New York dealer price, was about $49 million.

Salient Statistics—United States:	2008	2009	2010	2011	2012[e]
Production, refinery	—	—	—	—	—
Imports for consumption[1]	144	105	117	146	110
Exports	NA	NA	NA	NA	NA
Consumption, estimated	125	130	110	120	90
Price, annual average, dollars per kilogram:					
U.S. producer[2]	685	500	565	720	650
New York dealer[3]	519	382	552	685	540
99.99% c.i.f. Japan[4]	479	348	546	680	510
Stocks, producer, yearend	NA	NA	NA	NA	NA
Net import reliance[5] as a percentage of estimated consumption	100	100	100	100	100

Recycling: Data on the quantity of secondary indium recovered from scrap were not available. Indium is most commonly recovered from ITO. Sputtering, the process in which ITO is deposited as a thin-film coating onto a substrate, is highly inefficient; approximately 30% of an ITO target material is deposited onto the substrate. The remaining 70% consists of the spent ITO target material, the grinding sludge, and the after-processing residue left on the walls of the sputtering chamber. ITO recycling is concentrated in China, Japan, and the Republic of Korea—the countries where ITO production and sputtering take place.

An LCD manufacturer has developed a process to reclaim indium directly from scrap LCD panels. 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.

Import Sources (2008–11):[1] China, 29%; Canada, 23%; Japan, 14%; Belgium, 11%; and other, 23%.

Tariff: Item	Number	Normal Trade Relations 12–31–12
Unwrought indium, including powders	8112.92.3000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The annual average New York dealer price of indium decreased by approximately 21% in 2012 from that of 2011. The New York dealer price range for indium began the year at $630 to $670 per kilogram and decreased through late July, reaching a low of $485 to $520 per kilogram. The price range then increased beginning in September to $500 to $540 per kilogram, where it remained through early November. The U.S. producer price for indium began the year at $785 per kilogram. The price declined to $580 per kilogram in May and remained at that level through early November.

Prepared by **Amy C. Tolcin [(703) 648–4940, atolcin@usgs.gov]**

INDIUM

Japanese imports of indium were 115 tons during the first 8 months of 2012, a decrease of almost 70% compared with those during the same period in 2011. Leading import sources included the Republic of Korea, Canada, and the United States, in descending order of quantity. During the time period, imports from China decreased by 94% year on year, while imports from the United States increased by 184%.

The Chinese indium export quota decreased slightly in 2012 from that of 2011 to 231 tons, of which the quota for the first half of the year was set at 139 tons, and the quota for the second half of the year totaled 92 tons. The number of companies that received export licenses remained at 18 in 2012.

World Refinery Production and Reserves:

	Refinery production		Reserves[6]
	2011	2012[e]	
United States	—	—	Quantitative estimates of reserves are not available.
Belgium	30	30	
Brazil	5	5	
Canada	75	70	
China	380	390	
Japan	70	70	
Korea, Republic of	70	70	
Russia	5	5	
Other countries	27	30	
World total (rounded)	662	670	

World Resources: Indium's abundance in the continental crust is estimated to be approximately 0.05 part per million. Trace amounts of indium occur in base metal sulfides—particularly chalcopyrite, sphalerite, and stannite—by ionic substitution. Indium is most commonly recovered from the zinc-sulfide ore mineral sphalerite. The average indium content of zinc deposits from which it is recovered ranges from less than 1 part per million to 100 parts per million. Although the geochemical properties of indium are such that it occurs with other base metals—copper, lead, and tin—and to a lesser extent with bismuth, cadmium, and silver, most deposits of these metals are subeconomic for indium.

Vein stockwork deposits of tin and tungsten host the highest known concentrations of indium. However, the indium from this type of deposit is usually difficult to recover economically. Other major geologic hosts for indium mineralization include volcanic-hosted massive sulfide deposits, sediment-hosted exhalative massive sulfide deposits, polymetallic vein-type deposits, epithermal deposits, active magmatic systems, porphyry copper deposits, and skarn deposits.

Substitutes: Indium's recent price volatility and various supply concerns associated with the metal have accelerated the development of ITO substitutes. Antimony tin oxide coatings, which are deposited by an ink-jetting process, have been developed as an alternative to ITO coatings in LCDs and have been successfully annealed to LCD glass. Carbon nanotube coatings, applied by wet-processing techniques, have been developed as an alternative to ITO coatings in flexible displays, solar cells, and touch screens. Poly(3,4-ethylene dioxythiophene) (PEDOT) has also been developed as a substitute for ITO in flexible displays and organic light-emitting diodes. PEDOT can be applied in a variety of ways, including spin coating, dip coating, and printing techniques. Graphene quantum dots have been developed to replace ITO electrodes in solar cells and also have been explored as a replacement for ITO in LCDs. Researchers have recently developed a more adhesive zinc oxide nanopowder to replace ITO in LCDs. Gallium arsenide can substitute for indium phosphide in solar cells and in many semiconductor applications. Hafnium can replace indium in nuclear reactor control rod alloys.

[e]Estimated. NA Not available. — Zero.
[1]Imports for consumption of unwrought indium and indium powders (Tariff no. 8112.92.3000).
[2]Indium Corp.'s price for 99.97%-purity metal; 1-kilogram bar in lots of 10,000 troy ounces. Source: Platts Metals Week.
[3]Price is based on 99.99%-minimum-purity indium at warehouse (Rotterdam); cost, insurance, and freight (in minimum lots of 50 kilograms). Source: Platts Metals Week.
[4]Price is based on 99.99%-purity indium, primary or secondary, shipped to Japan. Source: Platts Metals Week.
[5]Defined as imports – exports + adjustments for Government and industry stock changes; exports were assumed to be no greater than the difference between imports and consumption.
[6]See Appendix C for resource/reserve definitions and information concerning data sources.