

# Indium

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Note: This is a brief review of indium in Canada with general information about indium and not a comprehensive review of indium metal.

The chemical symbol for indium is In.

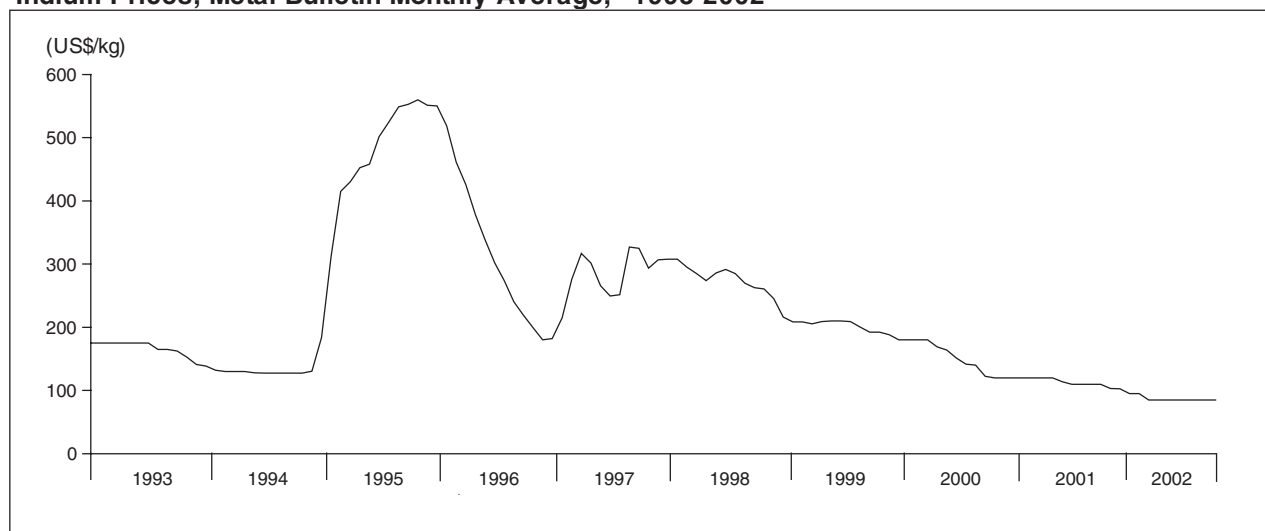
## WORLD CONTEXT

Indium is the by-product of the mining and processing of zinc. The United States Geological Survey (USGS) estimated that world production of refined indium in 2001 was about 340 t. The top five produc-

ers accounted for 88% of estimated world production in 2001. Chinese production has increased dramatically since 1999. The production of refined indium over time, which includes indium from recycled sources, is shown in Figure 1.

The most significant application for indium continues to be use as a coating for display screens used in computers and other electronic devices such as cell phones, instrumentation panels, CD players, etc. Indium is used in the form of an indium tin oxide, or ITO, which is transparent and electrically conductive. The ITO is "sputtered" onto glass targets. The sputtering process to deposit ITO onto targets is inefficient and results in a large number of rejects that are unsuitable for display screens. These rejects were left in stockpiles on the sites of many producers but, during the period of high prices for indium in the mid-1990s, manufacturers, especially in Japan, had a great incentive to develop ways to recycle the materials. In addition, manufacturers could invest in ways to decrease the rejection rate for the sputtering

Figure 1  
Indium Prices, Metal Bulletin Monthly Average,<sup>1</sup> 1993-2002



Source: *Metal Bulletin*.

<sup>1</sup> Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, ingots min. 99.97%.

targets. Together these measures allowed manufacturers to make more efficient use of indium.

According to press reports citing Roskill Information Services Ltd., supply potential also increased as producers increased recovery rates of indium from smelter flue dusts and residues at lead-zinc metallurgical plants to take advantage of higher prices. Reportedly, the recovery rate went from 30% to 80% in places, with improvements noted at Teck Cominco Limited's Trail operation, at Falconbridge Limited's Kidd Creek operation, and at Japanese producers. The other important supply factor has been the significant increase in Chinese production.

According to information released to the press in November 1999 and posted on the Roskill web site, Roskill (see below for details) estimated that demand for indium in 1998 was about 200 t. Of this, over half was used in ITO applications for electronics. Roskill forecasts the use of indium in electronic applications will rise to about 150 t by 2005. Other important indium-using sectors in 1998 were low-melting-point alloys, using 31 t, and semiconductor applications, using 19 t. Roskill predicted that the solar cell industry will use increasing quantities of copper-indium-diselenide.

## CANADIAN DEVELOPMENTS

Canadian indium production statistics are withheld for confidentiality reasons. Domestic production of indium is derived from the processing of zinc ores. Two facilities in Canada recover indium: Teck Cominco Limited's operation at Trail, British Columbia, and Falconbridge Limited's Kidd Creek operation in Timmins, Ontario. According to the USGS, Canada accounted for about 15% of the world's indium production in 2001. The USGS estimates that Canada has the largest reserve and resource base, accounting for 27% and 35%, respectively.

**Teck Cominco Limited** <[www.teckcominco.com](http://www.teckcominco.com)> recovers indium from the zinc-lead feed to its smelter in Trail, British Columbia. Lead smelter slag fume dust containing indium is collected and sent to the zinc facilities on site for further separation and is then sent to the high-purity indium plant.

Teck Cominco produces high-purity indium needed to make indium-tin oxide suitable for use in the electronics industry. A press report in early January 1995 indicated that the company was then producing at a rate of about 20 t/y (or two thirds of its then capacity of 30 t/y) and that production would increase during 1995. The company does not comment on its indium production rate or its capacity to produce indium. Feed from the stockpile began in mid-1999 and the company had estimated that it would be completely processed over a period of four years. Teck

Cominco is examining the potential for value-added production for its indium output.

The Kidd Metallurgical Division of **Falconbridge Limited** <[www.falconbridge.com](http://www.falconbridge.com)> in Timmins, Ontario, recovers indium from copper and zinc production. The indium is recovered from copper smelter flue dusts and is sent for recovery at a special indium recovery operation on site where indium is recovered as refined material. In late 1998 when Kidd experienced problems with its copper converter, a spokesperson put its annual indium production rate at about 22 t.

Kidd increased the purity of its material in the late 1990s. Falconbridge's annual report in 1999 stated that Noranda Inc. had become the sales agent for indium sales from Falconbridge. As of July 2002, Noranda owned 58.4% of the common shares of Falconbridge.

## Indium Properties in Canada

Mt. Pleasant was operated by Billiton Metals Canada as a tungsten operation during the first half of the 1980s, but closed because of low metal prices. From 1995 to 1996, **Adex Mining Corp.** evaluated the Mt. Pleasant property in New Brunswick. Adex took bulk samples and undertook a metallurgical research program at the site of the former mine as part of a feasibility study for tin and indium production. The high capital cost estimate and the low indium prices in 1997 meant that Adex was not able to develop the orebody. Adex was delisted in June 1999. The company did not maintain a web site at the time this article was written.

## PRICES

Indium prices from 1993 to 2000 are shown in Figure 1. During the two-year price surge from early 1995 to early 1997, manufacturers began recycling their off-specification material and producers concentrated on increasing recovery rates. The price history since that time indicates that supply and demand have generally been in balance.

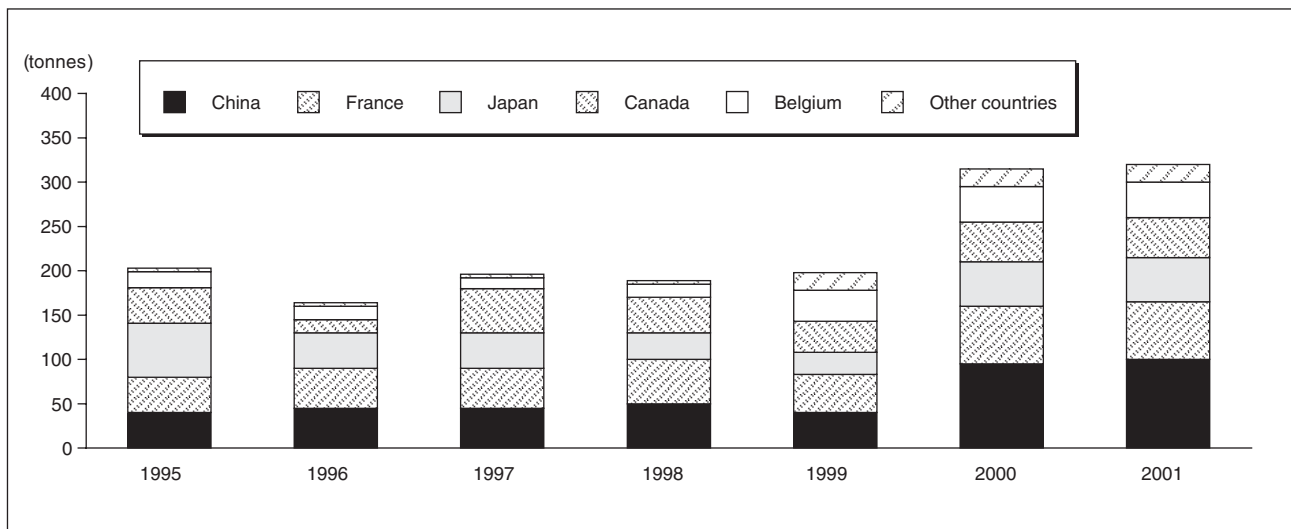
## PRODUCT INFORMATION

Those who wish to purchase indium should contact the producers. In Canada these are:

- Cominco Ltd. <[www.cominco.com](http://www.cominco.com)>
- Falconbridge Limited <[www.falconbridge.com](http://www.falconbridge.com)>

Additional information such as addresses and phone numbers are listed on their respective web sites.

**Figure 2**  
**World Refined Indium Production, 1995-2001**



Source: United States Geological Survey estimates.

Information about various indium products such as solders, sputtering targets, compounds, and alloys can be found at a number of web sites, including the following:

- Indium Corporation of America  
[www.indium.com](http://www.indium.com)

## INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to January 2002, include the following:

- United States Geological Survey (USGS):  
<http://minerals.usgs.gov/minerals/pubs/commodity/indium>
- Search by company name in the SEDAR data base for companies publicly traded in Canada:  
[www.sedar.com/search/search\\_form\\_pc\\_en.htm](http://www.sedar.com/search/search_form_pc_en.htm)
- *Canadian Mining Journal* (choose "Index and Archives" to see back issues):  
[www.canadianminingjournal.com](http://www.canadianminingjournal.com)
- *Northern Miner* (daily headlines):  
[www.northernminer.com](http://www.northernminer.com)
- Various on-line encyclopedias
- Any web search engine such as  
[www.google.com/advanced\\_search](http://www.google.com/advanced_search)
- For physical and chemical properties, concentrations in various media, etc.:  
[www.webelements.com/webelements/elements/text/In/key.html](http://www.webelements.com/webelements/elements/text/In/key.html)
- *American Metal Market*, search (some articles do not require paid subscription to access):  
[www.amm.com](http://www.amm.com)
- *Mining Journal*, search (some articles do not require paid subscription to access):  
[www.mining-journal.com/index1.htm](http://www.mining-journal.com/index1.htm)
- *Metal Bulletin* (information by paid subscription):  
[www.metalbulletin.co.uk](http://www.metalbulletin.co.uk)

## COMMERCIALY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services in the United Kingdom. Further information is available at the company's web site at [www.roskill.co.uk/indium.html](http://www.roskill.co.uk/indium.html).

Studies from other sources may be available.

*Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of January 27, 2002. (3) This article is not intended to be a comprehensive overview of the indus-*

try but, rather, is a brief report to provide information about Canadian developments in the world indium industry. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at [www.nrcan.gc.ca/mms/cmy/index\\_e.html](http://www.nrcan.gc.ca/mms/cmy/index_e.html).

## NOTE TO READERS

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## TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
8112.92	Unwrought; waste and scrap; powder				
8112.92.90.13	Unwrought indium, not alloyed; powders, not alloyed	2%	Free	Free	Free
8112.92.90.23	Unwrought indium, alloyed; waste and scrap; powders, alloyed	2%	Free	Free	Free
8112.92.90.30	Indium and articles thereof, n.e.s.	3%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

n.e.s. Not elsewhere specified.

TABLE 1. CANADA, INDIUM PRODUCTION AND IMPORTS, 1999-2001

Item No.	1999		2000		2001 (p)		
	(kg)	(\$000)	(kg)	(\$000)	(kg)	(\$000)	
<b>MINERAL PRODUCTION</b>	x	x	x	x	x	x	
<b>IMPORTS</b>							
8112.91.90.13	Unwrought indium, alloyed; waste and scrap; powders, alloyed						
	China	734	126	1 998	345	2 524	435
	United States	920	157	3 158	541	1 422	242
	Germany	1	...	21	3	4	1
	United Kingdom	122	21	-	-	-	-
	France	2 829	616	-	-	-	-
	<b>Total</b>	<b>4 606</b>	<b>920</b>	<b>5 177</b>	<b>889</b>	<b>3 950</b>	<b>678</b>
8112.91.90.23	Indium unwrought metal; powders						
	China	30	5	1 404	243	3 621	624
	United States	142	24	5	1	515	89
	United Kingdom	244	42	-	-	-	-
	Japan	12	2	-	-	-	-
	<b>Total</b>	<b>428</b>	<b>73</b>	<b>1 409</b>	<b>244</b>	<b>4 136</b>	<b>713</b>

Sources: Natural Resources Canada; Statistics Canada.

- Nil; ... Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.

Notes: Indium export statistics are included with certain other metals as a total and are therefore not available. Numbers may not add to totals due to rounding.