

Antimony

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The chemical symbol for antimony is Sb.

Canada produced a very minor share (0.1 %) of the approximately 170 000 t of antimony estimated to have been produced in mines worldwide in 2007. The production was derived from by-product antimony contained in base-metal concentrates produced in Canadian mines. Production and shipments of antimony in Canada by province from 2002 to 2006, and the 2007 preliminary estimate, are shown in Tables 1a and 1b. Total Canadian shipments of recoverable antimony in concentrates are shown in the table below and in Figure 1.

CANADIAN ANTIMONY PRODUCTION

Year	Mine		Shipments
	(t)	(t)	(\$000)
1997	630	529	1 610
1998	428	359	845
1999	425	357	733
2000	433	364	781
2001	278	234	518
2002	173	145	443
2003	153	129	426
2004	105	88	331
2005	79	66	283
2006	269	226	1 344
2007 (p)	241	203	1 231

(p) Preliminary.

In 1992 and 1993, Canadian production amounted to about 1% of world total primary mine production. With the anticipated start-up of the Beaver Brook mine in Newfoundland and Labrador in 2008, Canadian production and Canada's world share of production will rise.

China remains the dominant force in the world antimony market, having produced over 150 000 t in 2007, or over 87% of the world's total mine production.

The largest single application for antimony is in the manufacture of flame retardants used in plastics, vinyls, and synthetic fibres. Antimony is also used as an alloying element in lead for making automotive batteries; the addition of antimony increases the strength and hardness of the lead. When lead-acid automotive and lead-acid standby batteries are recycled, much of the contained antimony can be recovered for making antimonial lead for use in the battery-making process. Antimony metal is also used in solders and for bearings. Stibnite (Sb_2S_3) is the predominant ore mineral of antimony. Antimony metal is sold as regulus grading 96% antimony. The historical prices of antimony regulus are shown in Figure 2.

Antimony is alloyed with lead to improve the hardness. The resultant "hard lead," with a 3-9% antimony content, has superior strength and corrosion resistance relative to unalloyed lead. Hard lead is used in the grids, terminals, and lead-oxide paste of automotive and standby batteries. In addition, antimonial lead lining is used to protect pipes, valves, pumps, and sheets used in the chemical industry. Higher antimony contents of up to 13% are needed for casting alloys.

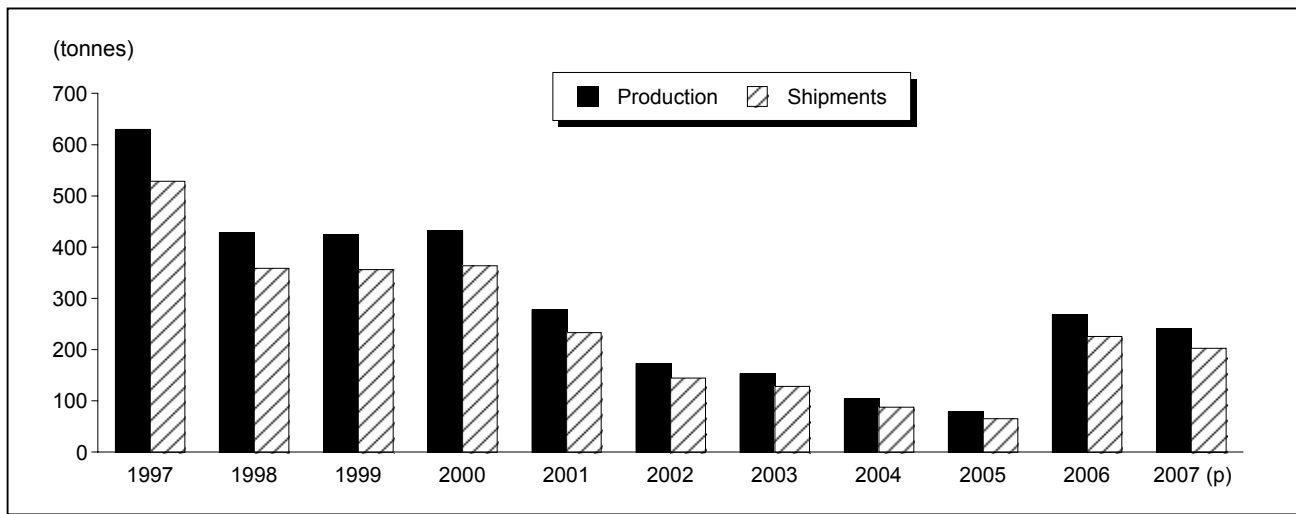
Other elements can be used to harden lead, such as cadmium, calcium, copper, selenium, strontium, sulphur, or tin. Hydrated aluminum oxide and certain organic compounds can be used for flame retardants. In paints, pigments and enamels, various compounds of chromium, tin, zinc, or zirconium can be used in place of antimony.

WORLD OVERVIEW

China is the major producer of antimony. Since 1995, China typically produced over 80% of the reported primary mine production of antimony. Four other countries (Russia, South Africa, Bolivia, and Tajikistan) together contributed about 10% of world primary mine production. All other countries together accounted for the remainder, which amounted to less than 5% of the world's primary supply since 2004. Figure 3 illustrates China's dominant position.

Demand for antimony is related to the world's industrial output and economic growth. The continued growth in commodity prices has been mirrored in antimony prices. The degree to which the price rise is sustained will depend

Figure 1
Canadian Antimony Production and Shipments, 1997-2007 (p)

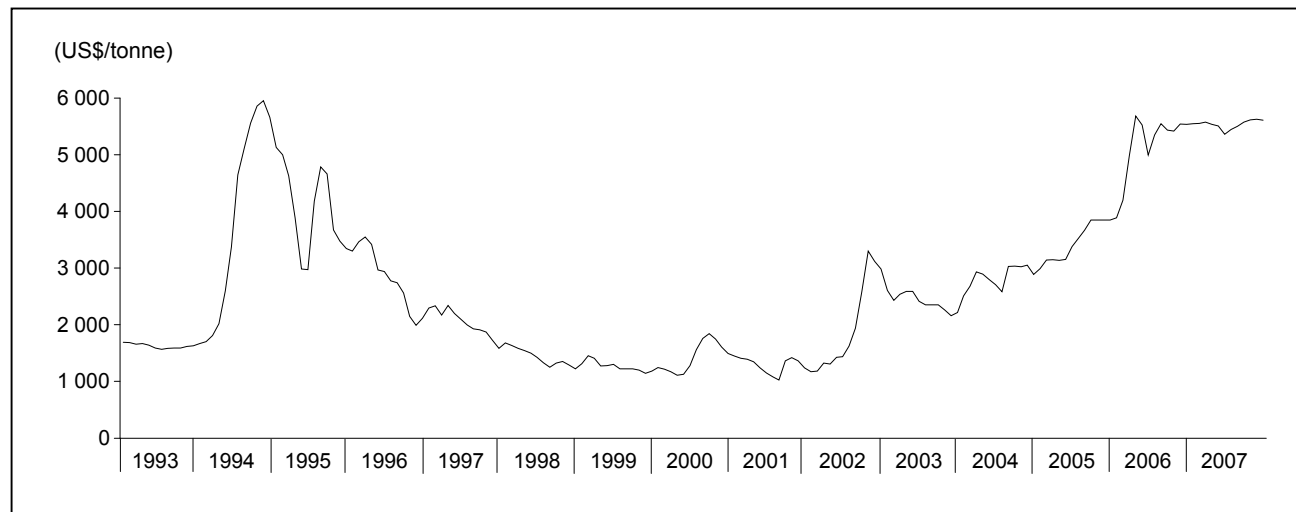


Source: Natural Resources Canada.

(p) Preliminary.

Notes: Production = antimony contained in concentrates produced. (2) Shipments = recoverable antimony.

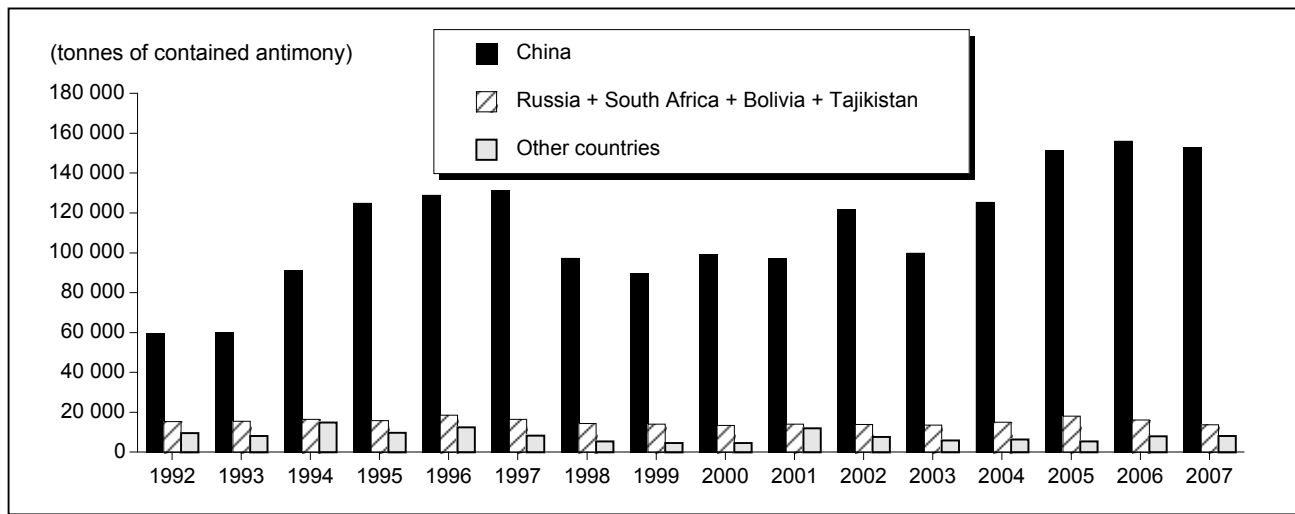
Figure 2
Antimony Regulus Price History, Monthly Average, (1) 1993-2007



Source: *Metal Bulletin*.

(1) Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, regulus 99.65%, maximum selenium content of 50 ppm.

Figure 3
World Antimony Mine Production, 1992-2007



Source: World Nonferrous Metal Statistics.

upon continued economic growth, the availability of antimony supply, and the penetration of substitutes for antimony. The U.S. Geological Survey noted a trend to low-maintenance batteries that use calcium instead of antimony additives.

CANADIAN DEVELOPMENTS

Antimony was recovered in Canada from domestic and imported concentrates that contained antimony and from recycled automotive batteries at two primary lead smelters that produce antimony-lead alloys. Two lead smelters were supplied exclusively from recyclable materials such as antimony-containing lead-acid batteries.

The Beaver Brook mine on the island of Newfoundland in the province of Newfoundland and Labrador was expected to re-open in early 2008. **Roycefield Resources Ltd.** had developed a 450-t/d operation in 1998, but low prices forced its closure and the operation was put into care and maintenance. An underground mine, a concentrator, and a hydrometallurgical demonstration plant to produce antimony trioxide were built at a cost of \$21 million to August 1998. The concentrator processed about 23 000 t of development material before its closure.

After the closure, **Beaver Brook Resources Ltd.** acquired the property in March 2002. In September 2003, **VVC Exploration Corporation** entered an agreement to purchase all the assets of the operation for \$17 million. The acquisition was completed in 2004. By the end of 2007, VVC had progressively divested itself of the Beaver Brook operation to concentrate its efforts on development in China.

VVC commissioned a scoping study in which an economic analysis of about 1 Mt of material grading 4.45% Sb_2O_3 at the Beaver Brook operation was completed. This material was contained in measured resources of 1.48 Mt of material grading 4.58% Sb_2O_3 .

Two technical reports about the Beaver Brook deposit were posted in 2004 to the System for Electronic Document Analysis and Retrieval (SEDAR), which is used for the electronic filing of information with Canadian securities regulatory authorities. These reports were available (in English only) at the following locations:

- www.sedar.com/GetFile.do?lang=EN&docClass=13&issuerNo=00007564&fileName=/csfsprod/data43/filings/00621930/00000001/C%3A\SEDAR\FILES\VVC\2004\VVC-BeaverBrook-MRB-Rep.pdf
- www.sedar.com/GetFile.do?lang=EN&docClass=13&issuerNo=00007564&fileName=/csfsprod/data43/filings/00621930/00000001/C%3A\SEDAR\FILES\VVC\2004\VVC-BBScopStudyRept-31Oct2004.pdf

Between 2005 and 2007, VVC progressively divested itself of the Beaver Brook operation from 100% ownership to 22% in January 2007, and thereafter to 10% by selling to **Beaver Brook Antimony Mine Inc.** (BBAM), a private company. In 2007, Wogen plc reached an agreement with BBAM to purchase a minority share in BBAM and to market the antimony concentrates from the operation. The operation was expected to start production in 2008.

The Lake George antimony deposit in New Brunswick has remained inactive since its closure in 1996.

There were two primary lead smelters in Canada: **Teck Cominco Limited**'s smelter at Trail, British Columbia, and **Xstrata plc**'s smelter at Belledune, New Brunswick. Both processed concentrate feeds that contained antimony, supplemented by recycled lead-acid batteries. Secondary lead smelters in Canada depend upon recycled lead-acid batteries from Canadian users supplemented by imports from the United States. The **Tonolli Canada Ltd.** smelter is located in Toronto, Ontario. **Newalta Income Fund** purchased the **Nova Pb Inc.** lead smelter near Montréal, Quebec, in late 2007; its lead-acid battery recyclable feed contained antimony.

Teck Cominco's lead-arsenic-antimony alloys contained between 1% and 10% antimony. No current details were available for the alloys produced by Xstrata, Newalta, or Tonolli.

PRICES

Metal Bulletin's free market prices for antimony regulus grading 99.65% antimony with a maximum selenium content of 50 ppm are shown in Figure 2 for the period 1993 to 2007. Prices reached a minimum monthly average of just over US\$1000/t in August 2001, thereafter surpassing US\$5000/t only in April 2006 when they averaged over US\$5600/t. Prices subsequently varied between about US\$5000/t and US\$5600/t until the end of 2007.

INTERNET INFORMATION SOURCES

Free sources of additional information about antimony available on the Internet include:

U.S. Geological Survey (USGS):

<http://minerals.usgs.gov/minerals/pubs/commodity/antimony/>

Search by company name in the SEDAR data base for companies publicly traded in Canada:

www.sedar.com/search/search_form_pc_en.htm

Canadian Mining Journal:

www.canadianminingjournal.com

Physical and chemical properties, concentrations in various media, etc.:

www.webelements.com/webelements/elements/text/Sb/key.html

International Antimony Oxide Industry Association:

www.nihonseiko.co.jp/english/environment/060418faq_e.pdf

European Flame Retardants Association:

www.flameretardants.eu/pdf/PDF_Fact/ATO.pdf

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65.

(2) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about antimony in Canada. More detailed information is available from the U.S. Geological Survey, whose web site is noted above. (3) 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. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan-rncan.gc.ca/mms-smm/busi-indu/cmy-amc/com-eng.htm.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States	EU	Japan
		MFN	GPT	USA	Canada	Conventional Rate (1)	WTO (2)
2617.10	Other ores and concentrates: antimony ores and concentrates	Free	Free	Free	Free	Free	Free
28.25	Hydrazine and hydroxylamine and their inorganic salts; other inorganic bases; other metal oxides, hydroxides and peroxides						
2825.80	Antimony oxides	Free	Free	Free	Free	5.5%	4.8-5.5%
29.18	Carboxylic acids with additional oxygen function and their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulphonated, nitrated or nitrosated derivatives						
2918.13.00.10	Salts and esters of tartaric acid: antimony potassium tartrates	Free	Free	Free	Free	6.5%	3.9%
81.10	Antimony and articles thereof, including waste and scrap						
8110.10.00	Unwrought antimony; powders: not alloyed and alloyed	Free	Free	Free	Free	7%	8.8yen/kg
8110.20	Waste and scrap	Free	Free	Free	Free	Free	8.8yen/kg
8110.90	Other	Free	Free	Free	Free	7%	8.8yen/kg

Sources: Canadian Customs Tariff, effective January 2008, Canada Border Services Agency; Harmonized Tariff Schedule of the United States, 2008; Official Journal of the European Union (Tariff Information), September 20, 2007 edition; Customs Tariff Schedules of Japan, 2008.

(1) The customs duties applicable to imported goods originating in countries that are Contracting Parties to the General Agreement on Tariffs and Trade or with which the European Community has concluded agreements containing the most-favoured-nation tariff clause shall be the conventional duties shown in column 3 of the Schedule of Duties. (2) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1a. CANADA, ANTIMONY PRODUCTION AND TRADE, 2005-07

		2005		2006		2007 (p)	
		(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
SHIPMENTS							
	New Brunswick	66	281	72	431	52	317
	Quebec	1	3	10	57	6	34
	British Columbia	-	-	144	856	145	880
	Total	67	283	226	1 344	203	1 231
EXPORTS							
2617.10	Antimony ores and concentrates						
	China	-	-	-	-	38	40
2825.80	Antimony oxides						
	Venezuela	-	-	-	-	2	10
	United States	1	10	-	-	1	3
	Total	1	10	-	-	3	13
8110.10	Unwrought antimony; powders						
	United States	105	1 191	126	1 147	10	95
	United Kingdom	-	-	-	-	1	47
	Switzerland	-	-	...	20	...	22
	Other countries	-	-	...	9	-	-
	Total	105	1 191	126	1 176	11	164
8110.90	Antimony and articles thereof, including waste and scrap, other						
	United Kingdom	1	59	88	139	2	68
	United States	2	185	...	55	...	36
	Other countries	2	66	...	3	-	-
	Total	5	310	88	197	2	104
	Total exports	111	1 511	214	1 373	54	321

TABLE 1a (cont'd)

		2005		2006		2007 (p)	
		(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
IMPORTS							
2617.10	Antimony ores and concentrates						
	Bolivia	17	57	91	315	192	727
	China	–	–	3	10	49	176
	United States	...	1	16	54	8	31
	Italy	83	290	–	–	–	–
	Total	100	348	110	379	249	934
2825.80	Antimony oxides						
	China	997	3 763	1 234	5 617	948	5 571
	Mexico	735	3 220	596	3 514	464	2 626
	United States	255	1 184	145	747	75	469
	Belgium	37	230	83	590	52	423
	Singapore	–	–	–	–	20	107
	Japan	–	–	4	18	3	15
	Other countries	...	...	8	49	1	6
	Total	2 024	8 397	2 070	10 535	1 563	9 217
2918.13.00.10	Antimony potassium tartrates						
	China	21	36	59	104	22	38
	Spain	–	–	–	–	16	29
	India	3	5	26	46	1	2
	United States	8	15	1	1	1	2
	Other countries	1	1	1	2	...	...
	Total	33	57	87	153	40	71
8110.10.00.10	Unwrought antimony, not alloyed; powders, not alloyed						
	China	83	330	108	439	20	123
	United States	198	738	157	597	14	78
	Other countries	23	86	1	3	–	–
	Total	304	1 154	266	1 039	34	201
8110.10.00.20	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	China	172	737	131	591	209	1 185
	Mexico	–	–	–	–	13	77
	United States	46	194	54	265	3	25
	Japan	–	–	1	3	–	–
	Peru	–	–	17	100	–	–
	Total	218	931	203	959	225	1 287
8110.20.00.00	Waste and scrap						
	China	–	–	5	29	18	70
	Belgium	–	–	–	–	14	54
	United States	29	159	8	44	–	–
	Total	29	159	13	73	32	124
8110.90.00.00	Other						
	China	38	148	47	180	61	278
	Germany	–	–	1	3	34	141
	United States	123	475	2	6	1	5
	United Kingdom	6	22	–	–	–	–
	India	–	–	...	...	–	–
	Total	167	645	50	189	96	424
	Total imports	2 875	11 691	2 799	13 327	2 239	12 258

Sources: Natural Resources Canada; Statistics Canada.
– Nil; ... Amount too small to be expressed; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 1b. CANADA, ANTIMONY PRODUCTION AND TRADE, 2002-04

		2002		2003		2004	
		(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
SHIPMENTS							
	New Brunswick	145	443	127	419	88	329
	Quebec	—	—	2	7	1	2
	British Columbia	—	—	—	—	—	—
	Total	145	443	129	426	89	331
EXPORTS							
2617.10	Antimony ores and concentrates						
	Japan	58 171	66 306	—	—	—	—
	South Africa	8	12	—	—	—	—
	United States	—	—	1	5	—	—
	Total	58 179	66 318	1	5	—	—
8110.10	Unwrought antimony; powders						
	United States	...	11	65	679	77	682
	Sweden	...	24	—	—	—	—
	Switzerland	2	24	—	—	—	—
	Ukraine	...	7	—	—	—	—
	Total	2	66	65	679	77	682
8110.20	Antimony waste and scrap						
	United States	6	60	—	—	6	62
8110.90	Antimony and articles thereof, including waste and scrap, other						
	United States	48	564	1	96	3	199
	Switzerland	—	—	1	62	...	41
	Germany	—	—	...	34	...	27
	United Kingdom	—	—	...	27	...	17
	Netherlands	—	—	—	—	...	12
	Ukraine	...	8	1	34	...	3
	Belgium	...	4	—	—	—	—
	Total	48	576	3	253	3	299
	Total exports	58 235	67 020	69	937	86	1 043
IMPORTS							
2617.10	Antimony ores and concentrates						
	United States	23	72	6	23	7	26
	China	—	—	...	...	—	—
	Total	23	72	6	23	7	26
2825.80	Antimony oxides						
	United States	1 521	5 979	1 410	5 116	1 422	5 674
	China	72	203	100	365	486	1 845
	Mexico	83	278	15	68	209	768
	Belgium	81	236	162	550	15	68
	Switzerland	—	—	—	—	1	4
	Germany	...	...	—	—	...	...
	Total	1 757	6 696	1 687	6 099	2 133	8 359
2918.13.00.10	Antimony potassium tartrates						
	China	15	18	31	55	30	52
	United States	10	14	16	30	1	1
	Italy	66	109	10	18	...	...
	Germany	—	—	...	...	...	...
	South Africa	—	—	—	—	...	...
	India	...	...	62	88	—	—
	Switzerland	1	1	...	...	—	—
	Total	92	142	119	191	31	53

TABLE 1b (cont'd)

		2002		2003		2004	
		(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
IMPORTS (cont'd)							
8110.10.00.10	Unwrought antimony, not alloyed; powders, not alloyed						
	United States	134	437	204	769	200	749
	China	26	105	28	98	102	407
	Canada	2	5	–	–	–	–
	Germany	16	55	–	–	–	–
	Japan	3	10	3	11	–	–
	Switzerland	–	–	1	4	–	–
	Vietnam	–	–	20	65	–	–
	Total	181	612	256	947	302	1 156
8110.10.00.20	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	China	80	233	96	354	159	550
	United States	96	311	44	161	46	198
	Germany	8	18	...	...	–	–
	Total	184	562	140	515	205	748
8110.20.00.00	Waste and scrap						
	United States	14	84	14	78	63	350
	China	51	122	–	–	–	–
	Japan	4	20	–	–	–	–
	Total	69	226	14	78	63	350
8110.90.00.00	Other						
	United States	174	646	49	216	86	319
	China	26	66	60	204	50	171
	Japan	5	17	1	4	1	2
	Canada	...	2	–	–	–	–
	Total	205	731	110	424	137	492
	Total imports	2 511	9 041	2 332	8 277	2 878	11 184

Sources: Natural Resources Canada; Statistics Canada.

– Nil; ... Amount too small to be expressed.

Note: Numbers may not add to totals due to rounding.

**TABLE 2. CANADA, USE OF ANTIMONY,
1988-2006**

	Use (1) Antimony Metal	Use Antimonial Lead Alloy(2)
	(kg)	
1988	585 600	989 100
1989	442 942	1 075 354
1990	294 321	922 127
1991	406 221	924 728
1992	355 963	829 795
1993	688 542	884 344
1994	1 084 863	856 959
1995	988 338	822 848
1996	688 800	733 730
1997	1 158 210	665 751
1998	791 255	589 087
1999	865 383	634 294
2000	777 505	674 829
2001	486 682	677 365
2002	487 013	724 206
2003	557 905	822 870
2004	534 980	819 980
2005	576 972	(r) 789 318
2006	717 693	684 657

Source: Natural Resources Canada.

(r) Revised.

(1) Available data, as reported by users. (2) Antimony content of primary and recycled antimonial-lead alloys.

Note: Numbers may not add to totals due to rounding.