

## CADMIUM

(Data in metric tons of cadmium content unless otherwise noted)

**Domestic Production and Use:** Three companies in the United States were thought to have produced cadmium metal in 2008. One company, operating in Tennessee, recovered cadmium as a byproduct of zinc leaching from roasted sulfide concentrates. The other two companies, with facilities located in Ohio and Pennsylvania, thermally recovered cadmium metal from spent nickel-cadmium (NiCd) batteries and other cadmium-bearing scrap. Based on the average New York dealer price, U.S. cadmium metal consumption was valued at about \$3.87 million in 2008.

<b>Salient Statistics—United States:</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008<sup>e</sup></b>
Production, refinery <sup>1</sup>	1,480	1,470	723	735	745
Imports for consumption, metal only	102	207	179	315	182
Imports for consumption, metal, alloys, scrap	263	288	180	316	221
Exports, metal only	22	(2)	18	270	362
Exports, metal, alloys, scrap	154	686	483	424	440
Consumption of metal, apparent	1,840	699	568	585	564
Price, metal, average annual: <sup>3</sup>					
Dollars per kilogram	1.20	3.30	2.98	7.61	6.86
Dollars per pound	0.55	1.50	1.35	3.45	3.11
Stocks, yearend, producer and distributor	1,170	1,540	1,400	1,440	1,400
Net import reliance <sup>4</sup> as a percentage of apparent consumption	20	E	E	E	E

**Recycling:** Cadmium is mainly recovered from spent consumer and industrial NiCd batteries. Other waste and scrap from which cadmium can be recovered includes copper-cadmium alloy scrap, some complex nonferrous alloy scrap, and cadmium-containing dust from electric arc furnaces (EAF). The amount of cadmium recycled was not disclosed.

**Import Sources (2004-07):** Metal:<sup>5</sup> Australia, 31%; Mexico, 27%; Canada, 14%; Peru, 9%; and other, 19%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations<sup>6</sup> 12-31-08</b>
Cadmium oxide	2825.90.7500	Free.
Cadmium sulfide	2830.90.2000	3.1% ad val.
Pigments and preparations based on cadmium compounds	3206.49.6010	3.1% ad val.
Unwrought cadmium and powders	8107.20.0000	Free.
Cadmium waste and scrap	8107.30.0000	Free.
Wrought cadmium and other articles	8107.90.0000	4.4% ad val.

**Depletion Allowance:** 22% (Domestic), 14% (Foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** Most of the world's primary cadmium (approximately 51%) was being produced in Asia and the Pacific—specifically China, Japan, and the Republic of Korea—followed by North America (22%), Central Europe and Eurasia (18%), and Western Europe (6%). Global secondary cadmium production accounted for approximately 20% of all cadmium metal production, and this percentage was expected to increase in the future.

Cadmium use in batteries amounted to an estimated 83% of global consumption. The remaining 17% was distributed as follows: pigments, 8%; coatings and plating, 7%; stabilizers for plastics, 1.2%; and nonferrous alloys, photovoltaic devices, and other, 0.8%. The percentage of cadmium consumed globally for NiCd battery production has been increasing, while the percentages for the other traditional end uses of cadmium—specifically coatings, pigments, and stabilizers—have gradually decreased, owing to environmental and health concerns. A large percentage of the global NiCd battery market was concentrated in Asia.

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NiCd battery use in consumer electronics was thought to be declining owing partly to the preference for other rechargeable battery chemistries—particularly lithium ion (Li-ion) batteries, which have already replaced NiCd batteries to a large degree in laptops and cell phones. Li-ion batteries are used in lightweight electronic devices because of their greater energy density (power-to-weight ratio). However, demand for cadmium may increase owing to several new market opportunities for NiCd batteries, particularly in industrial applications. NiCd batteries currently power a large percentage of battery electric vehicles. Industrial-sized NiCd batteries could also be used to store energy produced by certain on-grid photovoltaic systems. Peak energy produced during the midday would be stored in a NiCd battery and later dispatched during periods of high electricity demand.

Concern over cadmium's toxicity has spurred various recent legislative efforts, especially in the European Union, to restrict the use of cadmium in most of its end-use applications. The final effect of this legislation on global cadmium consumption has yet to be seen. If recent legislation involving cadmium dramatically reduces long-term demand, a situation could arise, such as has been recently seen with mercury, where an accumulating oversupply of byproduct cadmium will need to be permanently stockpiled.

### **World Refinery Production, Reserves, and Reserve Base:**

	Refinery production		Reserves <sup>7</sup>	Reserve base <sup>7</sup>
	2007	2008 <sup>e</sup>		
United States	735	745	43,000	67,000
Australia	350	350	66,000	260,000
Canada	2,100	2,100	23,000	84,000
China	4,000	4,100	99,000	280,000
Germany	640	640	—	8,000
India	580	620	21,000	49,000
Japan	1,930	2,000	—	—
Kazakhstan	2,100	2,100	41,000	89,000
Korea, Republic of	3,400	3,500	—	—
Mexico	1,620	1,620	21,000	39,000
Netherlands	500	500	—	—
Peru	420	420	54,000	87,000
Russia	810	850	12,000	37,000
Other countries	1,205	1,250	110,000	200,000
World total (rounded)	20,400	20,800	490,000	1,200,000

**World Resources:** Cadmium is generally recovered as a byproduct from zinc concentrates. Zinc-to-cadmium ratios in typical zinc ores range from 200:1 to 400:1. Sphalerite (ZnS), the most economically significant zinc mineral, commonly contains minor amounts of other elements; cadmium, which shares certain similar chemical properties with zinc, will often substitute for zinc in the sphalerite crystal lattice. The cadmium mineral greenockite (CdS) is frequently associated with weathered sphalerites and wurtzites [(Zn, Fe)S] but usually at microscopic levels. Estimated world identified resources of cadmium were about 6 million tons, based on identified zinc resources of 1.9 billion tons containing about 0.3% cadmium. Zinc-bearing coals of the Central United States and Carboniferous age coals of other countries also contain large subeconomic resources of cadmium.

**Substitutes:** Lithium-ion and nickel-metal hydride batteries are replacing NiCd batteries in some applications. However, the higher cost of these substitutes restricts their use in less expensive products. Except where the surface characteristics of a coating are critical (e.g., fasteners for aircraft), coatings of zinc or vapor-deposited aluminum can be substituted for cadmium in many plating applications. Cerium sulfide is used as a replacement for cadmium pigments, mostly in plastics. Barium/zinc or calcium/zinc stabilizers can replace barium/cadmium stabilizers in flexible polyvinylchloride applications.

<sup>e</sup>Estimated. E Net exporter. — Zero.

<sup>1</sup>Cadmium metal and oxide produced as a byproduct of lead-zinc refining plus metal from recycling.

<sup>2</sup>Less than ½ unit.

<sup>3</sup>Average New York dealer price for 99.95% purity in 5-short-ton lots. Source: Platts Metals Week.

<sup>4</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>5</sup>Imports for consumption of unwrought metal and metal powders (Tariff no. 8107.20.0000).

<sup>6</sup>No tariff for Australia, Canada, and Mexico for items shown.

<sup>7</sup>See Appendix C for definitions.