

CADMIUM

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

Domestic Production and Uses: Two companies, one in Illinois and one in Tennessee, recovered cadmium as a byproduct of the smelting and refining of zinc concentrates. A third company, in Pennsylvania, began recovering cadmium from spent nickel-cadmium (Ni-Cd) batteries at the end of 1995. Based on the average New York dealer price, the combined output of primary and secondary metal in 1996 was valued at \$4.0 million. The estimated consumption pattern included batteries, 67%; pigments, 14%; coatings and plating, 8%; stabilizers for engineering plastics and similar synthetic products, 8%; nonferrous alloys, 2%; and other, including electrooptics, 1%.

Salient Statistics—United States:	1992	1993	1994	1995	1996^e
Production, refinery ¹	1,620	1,090	1,010	1,270	1,450
Imports for consumption, metal	1,960	1,420	1,110	848	720
Exports of metal, alloys, and scrap	213	38	1,450	1,050	40
Shipments from Government stockpile excesses	—	185	209	214	243
Consumption, apparent	3,270	3,010	1,040	1,160	2,200
Price, metal, dollars per pound ²	0.91	0.45	1.13	1.84	1.25
Stocks, yearend, producer and distributor	933	579	423	542	750
Employment, smelter and refinery, number	190	195	125	125	145
Net import reliance ³ as a percent of apparent consumption	50	64	3	E	33

Recycling: To date, cadmium recycling has been practical only for Ni-Cd batteries, some alloys, and dust from electric arc furnaces. The exact amount recycled is not known. In 1995, the U.S. steel industry generated more than 500,000 tons of electric furnace dust, typically containing 0.003% to 0.07% Cd. At least 20 States have collection networks for recycling Ni-Cd batteries.

Import Sources (1992-95): Metal: Canada, 42%; Belgium, 15%; Mexico, 12%; Germany, 7%; and other, 24%.

Tariff: Item	Number	Canada and Mexico 12/31/96	Most favored nation (MFN) 12/31/96	Non-MFN⁴ 12/31/96
Cadmium sulfide	2830.30.0000	Free	3.1% ad val.	25% ad val.
Pigments and preparations based on cadmium compounds	3206.30.0000	Free	3.1% ad val.	25% ad val.
Unwrought cadmium; waste and scrap; powders	8107.10.0000	Free	Free	33¢/kg.

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

Government Stockpile:

Stockpile Status—9-30-96

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 96
Cadmium	2,020	115	2,020	—

Events, Trends, and Issues: Demand for rechargeable Ni-Cd batteries continued to grow worldwide, although at a somewhat slower rate than in past years. More than 60% of the cadmium consumed by Western countries goes into batteries, making batteries the principal end use. Japan continued to be the largest refiner of cadmium and also a net importer of cadmium metal. About 91% of the cadmium consumed by Japanese industry goes into batteries.

About 75% of the Ni-Cd batteries being produced by Western manufacturers are for cellular telephones and other cordless electronic equipment. The remaining 25% are used for industrial purposes, such as emergency power supplies for telephone exchanges and hospital operating rooms. These percentages are expected to change as sales of electric vehicles (EV's) accelerate in the United States, the European Union, and Japan.

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Ni-Cd batteries could conceivably capture 30% of the midterm (2000-2005) EV battery market, but competition from both lithium-ion and nickel-metal hydride batteries may be intense because of environmental concerns about cadmium. Much of the battery development work in the United States and Japan was driven by the impending requirement that, by 2003, 10% of new vehicles sold in California must be emission free. The U.S. Advanced Battery Consortium, a partnership between domestic automobile manufacturers and the Electric Power Research Institute, is working with the U.S. Department of Energy to evaluate and improve a variety of prototype battery systems for EV's. Seven U.S. and Japanese automobile manufacturers were prepared to meet the 2003 deadline and at least three planned to offer new production models for purchase or lease before the end of 1997. In Europe, French automobile manufacturers are poised to mass-produce Ni-Cd powered EV's, after field testing some 50 EV's for more than 6 years at the port of La Rochelle. Most of the EV's in the La Rochelle tests are powered by Ni-Cd batteries. In October 1996, British sponsors bought 14 French EV's to field test them in the Midlands city of Coventry for at least a year. France planned to have 100,000 EV's on its highways by the year 2000.

On May 11, 1995, the U.S. Environmental Protection Agency published new, simplified regulations governing the collection and management of spent Ni-Cd batteries and several other widely generated hazardous wastes. The regulations were designed to encourage environmentally sound recycling of Ni-Cd batteries and to keep them out of the municipal waste stream. The bulk of the batteries currently being collected go to a nickel and chromium reclamation plant in western Pennsylvania, where the cadmium is recovered in an innovative, \$5 million facility - the first of its kind. The cadmium is fumed off in special distillation furnaces, condensed, and cast into shot with a purity greater than 99.95%. Cadmium also is recovered from lead-zinc baghouse dust, which is generated on site during the smelting of stainless steel wastes.

The U.S. market for cadmium-based pigments has shrunk significantly since 1988 because of the adoption of stricter environmental regulations and the increased availability of alternative pigments. Both suppliers and consumers are concerned about recyclability and potential liability. Further substitution, however, is becoming increasingly difficult.

The price of cadmium metal has been extremely volatile over the last 10 years. At one point in 1988, the weekly quotation reached \$8.50 to \$9.10 per pound. In 1992, the price collapsed because of global recessionary forces, the loss of traditional markets, which was due to environmental concerns, and the introduction of stricter occupational exposure standards. An all time low of \$0.38 to \$0.48 per pound was recorded in the spring of 1993. The price partially recovered in late 1994 and peaked at \$2.05 to \$2.20 on November 21, 1995, only to falter again in mid-1996. The quotation on November 22, 1996, was \$0.80 to \$0.90.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves ⁵	Reserve base ⁵
	1995	1996 ^e		
United States	1,270	1,450	70,000	210,000
Australia	842	950	55,000	150,000
Belgium	1,710	1,700	—	—
Canada	2,360	2,400	80,000	170,000
Germany	1,150	1,200	6,000	8,000
Japan	2,652	2,700	10,000	15,000
Mexico	689	700	35,000	40,000
Other countries	<u>7,830</u>	<u>7,900</u>	<u>280,000</u>	<u>380,000</u>
World total (rounded)	18,500	19,000	540,000	970,000

World Resources: Estimated world resources of cadmium were about 6 million tons based on zinc resources containing about 0.3% cadmium. The zinc-bearing coals of the midcontinental United States and Carboniferous-age coals of other countries also contain large potential resources of cadmium.

Substitutes: Coatings of zinc or vapor-deposited aluminum can substitute for cadmium in some plating applications. However, cadmium is still required in situations where the surface characteristics of the coating are critical (e.g., fasteners for aircraft). Cerous sulfide (Ce₂S₃) was being evaluated as an alternative to some of the red cadmium-based pigments used to color plastics.

^eEstimated. E Net exporter.

¹Primary and secondary metal.

²Average New York dealer price for 99.95% purity in 5-short-ton lots. Source: *Platt's Metals Week*.

³Defined as imports - exports + adjustments for Government and industry stock changes.

⁴See Appendix B.

⁵See Appendix C for definitions.