

## CADMIUM

(Data in metric tons unless otherwise specified)

**Domestic Production and Use:** One company operating in Tennessee recovered an estimated 300 tons of primary cadmium metal valued at \$1.2 million as a byproduct of zinc leaching from roasted sulfide concentrates at the only domestic zinc smelter. In 2024, with a shift in focus to lithium-ion battery recycling, a company in Ohio that had been recovering secondary cadmium metal shut down its nickel cadmium (NiCd) battery recycling line. Another battery recycling company, established in Ohio in 2022, processed both consumer and industrial NiCd batteries for salable metals and was recovering cadmium metal in 2024 and planned to refine it to battery-grade purity. Cadmium metal and compounds are mainly consumed for NiCd batteries, but also for alloys, coatings, and pigments. An increasing use for cadmium was in cadmium-telluride (CdTe) thin-film solar panels, and in cadmium-zinc-telluride (CdZnTe) substrates for radiation detectors and imaging applications.

<b><u>Salient Statistics—United States:</u></b>	<b><u>2020</u></b>	<b><u>2021</u></b>	<b><u>2022</u></b>	<b><u>2023</u></b>	<b><u>2024<sup>e</sup></u></b>
Production:					
Primary, refined <sup>1</sup>	211	241	212	375	300
Secondary	W	W	W	W	W
Imports for consumption:					
Unwrought cadmium and powders	282	155	99	72	7
Wrought cadmium and other articles	3	2	1	1	3
Cadmium waste and scrap	90	85	40	(2)	26
Cadmium oxide	28	14	33	37	17
Cadmium sulfide	4	—	(2)	—	20
Cadmium pigments and preparations based on cadmium compounds	69	101	146	147	120
Exports:					
Unwrought cadmium and powders	4	51	68	100	20
Wrought cadmium and other articles	482	217	60	21	30
Cadmium waste and scrap	(2)	—	2	14	—
Cadmium pigments and preparations based on cadmium compounds	2,120	550	747	947	500
Consumption of metal, apparent <sup>3</sup>	W	W	W	W	W
Price, metal, annual average, <sup>4</sup> dollars per kilogram	2.29	2.56	3.42	4.06	4.1
Net import reliance <sup>5</sup> as a percentage of apparent consumption	<75	<50	<25	E	E

**Recycling:** Secondary cadmium is mainly recovered from spent consumer and industrial NiCd batteries. Other waste and scrap from which cadmium can be recycled includes copper-cadmium alloy scrap, some complex nonferrous alloy scrap, cadmium-containing dust from electric-arc furnaces, and CdTe solar panels.

**Import Sources (2020–23):**<sup>6</sup> China,<sup>7</sup> 34%; Germany, 31%; Australia, 23%; Peru, 10%; and other, 2%.

<b><u>Tariff:</u></b>	<b><u>Item</u></b>	<b><u>Number</u></b>	<b><u>Normal Trade Relations</u></b> <b><u>12–31–24</u></b>
	Cadmium oxide	2825.90.7500	Free.
	Cadmium sulfide	2830.90.2000	3.1% ad valorem.
	Pigments and preparations based on cadmium compounds	3206.49.6010	3.1% ad valorem.
	Cadmium waste and scrap	8112.61.0000	Free.
	Unwrought cadmium and powders	8112.69.1000	Free.
	Wrought cadmium and other articles	8112.69.9000	4.4% ad valorem.

**Depletion Allowance:** 22% (domestic), 14% (foreign).

**Government Stockpile:**<sup>8</sup> The fiscal year (FY) 2025 potential acquisitions include 2,800 square centimeters of CdZnTe substrates, a 180% increase from 1,000 square centimeters in FY 2024.

### **Events, Trends, and Issues:**

For the second consecutive year, the United States was a net exporter of cadmium. Average prices for cadmium decreased midyear, reflecting the seasonal buying patterns in India, and ended the year higher than those in January. India was the leading importer of cadmium metal; more than 11,400 tons were imported in 2023, and almost 6,000 tons as of August 2024. Though significant quantities of cadmium sponge were produced in India as a

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byproduct of zinc smelting, no production of cadmium metal was reported as of August 2024 in monthly statistics published by the Indian Bureau of Mines. Based on estimated production of cadmium as well as imports and exports, China replaced India as the leading consumer of cadmium in 2024.

Cadmium use in semiconductors continued to increase, especially CdTe in thin-film solar panels. The Inflation Reduction Act of 2022 provided tax incentives to transition to clean energy including for the domestic manufacturing of solar modules and components. The leading domestic CdTe solar panel manufacturer, based in Ohio, began commercial production in the third quarter of 2024 at a fourth facility, located in Alabama, that increased manufacturing capacity to almost 11 gigawatts (GW) per year. A fifth site was under construction in Louisiana and was expected to add another 3.5 GW per year in the second half of 2025. Worldwide, capacity was about 21 GW per year including a facility in India that opened in early 2024. In January, the National Renewable Energy Laboratory, administrator of the 3-year Cadmium Telluride Photovoltaics Accelerator Program, announced that \$1.8 million had been awarded in a second round of contracts to support development of CdTe solar cells that would be more efficient and have a lower cost.

### World Refinery Production and Reserves:

	Refinery production <sup>e</sup>		Reserves <sup>9</sup>
	<u>2023</u>	<u>2024</u>	
United States <sup>1</sup>	<sup>10</sup> 375	300	Quantitative estimates of reserves were not available. The cadmium content of typical zinc ores averages about 0.03%. See the Zinc chapter for zinc reserves.
Australia	900	900	
Bulgaria	310	300	
Canada	1,800	1,700	
China	9,300	9,300	
Germany	—	170	
Japan	1,800	1,700	
Kazakhstan	1,000	1,000	
Korea, Republic of	4,500	4,500	
Mexico	<sup>10</sup> 1,020	1,200	
Netherlands	<sup>10</sup> 726	400	
Norway	420	350	
Peru	<sup>10</sup> 494	620	
Poland	250	250	
Russia	1,000	800	
Uzbekistan	<u>220</u>	<u>200</u>	
World total (rounded)	24,100	24,000	

**World Resources:**<sup>9</sup> Cadmium is generally recovered from zinc ores and concentrates. Sphalerite, the most economically significant zinc ore mineral, commonly contains minor amounts of cadmium, which shares certain similar chemical properties with zinc and often substitutes for zinc in the sphalerite crystal lattice. The cadmium mineral greenockite is frequently associated with weathered sphalerite and wurtzite.

**Substitutes:** Batteries with other chemistries, particularly lithium-ion, can replace NiCd batteries in many applications. Except where the surface characteristics of a coating are critical (for example, fasteners for aircraft), coatings such as zinc-nickel can be substituted for cadmium in many plating applications. Cerium sulfide is used as a replacement for cadmium pigments, mostly in plastics. Barium stabilizers can replace barium-cadmium stabilizers in flexible polyvinyl chloride (PVC) applications. Thin-film technologies based on copper-indium-gallium-selenide and perovskite materials continued to be investigated but were not yet commercially feasible.

<sup>e</sup>Estimated. E Net exporter. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>1</sup>Cadmium metal produced as a byproduct of zinc refining.

<sup>2</sup>Less than ½ unit.

<sup>3</sup>Defined as primary production + secondary production + imports of unwrought cadmium and powders – exports of unwrought cadmium and powders.

<sup>4</sup>Average free market price for 99.95% purity in 10-ton lots; cost, insurance, and freight; global ports. Source: Fastmarkets MB.

<sup>5</sup>Defined as imports of unwrought cadmium and powders – exports of unwrought cadmium and powders.

<sup>6</sup>Unwrought cadmium and powders; Harmonized Tariff Schedule of the United States code 8107.20.0000 for 2019–21 and 8112.69.1000 beginning in 2022.

<sup>7</sup>Includes Hong Kong.

<sup>8</sup>See Appendix B for definitions.

<sup>9</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>10</sup>Reported.