CADMIUM

(Data in metric tons unless otherwise specified)

Domestic Production and Use: One company operating in Tennessee recovered primary cadmium metal as a byproduct of zinc leaching from roasted sulfide concentrates that would otherwise need to be disposed of as waste. One company operating in Ohio recovered secondary cadmium metal through the recycling of spent nickel-cadmium (NiCd) batteries. 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.

Salient Statistics—United States:	2019	2020	2021	2022	2023[e]
Production:					
Primary, refined[1]	131	211	241	212	220
Secondary	W	W	W	W	W
Imports for consumption:					
Unwrought cadmium and powders	385	282	155	99	80
Wrought cadmium and other articles	21	3	2	1	1
Cadmium waste and scrap	86	90	85	40	1
Cadmium oxide	33	28	14	33	30
Cadmium pigments and preparations based on cadmium compounds	108	69	101	146	130
Exports:					
Unwrought cadmium and powders	32	4	51	68	150
Wrought cadmium and other articles	84	482	217	60	14
Cadmium waste and scrap	6	([2])	—	2	15
Cadmium pigments and preparations based on cadmium compounds	795	2,120	550	747	1,100
Consumption of metal, apparent[3]	W	W	W	W	W
Price, metal, annual average,[4] dollars per kilogram	2.67	2.29	2.56	3.42	4.10
Net import reliance[5] as a percentage of apparent consumption	<75	<75	<50	<25	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 (2019–22):[6] Germany, 30%; Australia, 25%; China,[7] 18%; Peru, 11%; and other, 16%.

Tariff: Item	Number	Normal Trade Relations 12–31–23
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:[8] The fiscal year (FY) 2024 potential acquisitions include 1,000 square centimeters of CdZnTe substrates.

Events, Trends, and Issues: Imports of unwrought cadmium have generally been greater than exports, but in recent years imports have decreased while exports have increased. Based on estimated data, the United States become a net exporter in 2023. The average cadmium price began the year at $3.97 per kilogram in January, increased to $5.35 per kilogram in April, decreased midyear, and rose to $4.35 per kilogram by October. These prices reflected seasonal buying patterns in India, which, as a major importer, was an important determinant of cadmium prices in the spot market. In 2023, cadmium was added to India's list of 30 critical minerals. Cadmium was not included on the most recent U.S. critical minerals list because of low supply risk. In 2023, a company in Ohio was developing a facility capable of recovering cadmium and other metals through the recycling of NiCd batteries.

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CADMIUM

Cadmium use in semiconductors was increasing, especially CdTe in thin-film solar panels. The leading domestic CdTe solar panel manufacturer, also the world leader, began commercial production in early 2023 at a third facility in Ohio, bringing its domestic capacity to 5.9 gigawatts per year. A fourth facility, initiated in 2022, was under construction in Alabama and would add 3.5 gigawatts per year of capacity after planned completion in 2025. In June, plans for a fifth facility were announced and, in September, construction began in Louisiana that would add 3.5 gigawatts per year of capacity by 2026. The capacity increases were in part owing to the Inflation Reduction Act of 2022, which included incentives for transitioning to renewable energy sources. According to the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), 34% of utility-scale photovoltaics and 21% of all photovoltaic systems were CdTe-based at yearend 2022. NREL was the administrator of the Cadmium Telluride Photovoltaics Accelerator Program, in its second year, which continued to provide research grants with the goals of achieving cell efficiencies of 24% by 2025 and 26% by 2030 while decreasing costs, and to maintain or increase domestic CdTe photovoltaic material and module production. The company supplying CdTe feedstock, with facilities in Canada and the United States, secured a domestic source of tellurium in late 2022 and produced cadmium-zinc-telluride substrates for security and medical imaging applications at a facility in Utah.

World Refinery Production and Reserves:

	Refinery production[e]		Reserves[9]
	2022	2023	
United States[1]	[10]212	220	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	[10]328	380	
Bulgaria	340	340	
Canada	1,800	1,800	
China	8,700	9,000	
Germany	320	—	
Japan	1,800	1,800	
Kazakhstan	1,000	1,000	
Korea, Republic of	4,000	4,000	
Mexico	[10]1,170	1,100	
Netherlands	574	750	
Norway	420	380	
Peru	[10]460	790	
Poland	250	230	
Russia	1,000	1,000	
Uzbekistan	220	220	
World total (rounded)	22,600	23,000	

World Resources:[9] 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.

[e]Estimated. E Net exporter. W Withheld to avoid disclosing company proprietary data. — Zero.

[1]Cadmium metal produced as a byproduct of zinc refining.

[2]Less than ½ unit.

[3]Defined as primary production + secondary production + imports of unwrought cadmium and powders – exports of unwrought cadmium and powders.

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

[5]Defined as imports of unwrought cadmium and powders – exports of unwrought cadmium and powders.

[6]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.

[7]Includes Hong Kong.

[8]See Appendix B for definitions.

[9]See Appendix C for resource and reserve definitions and information concerning data sources.

[10]Reported.