

CADMIUM

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

Domestic Production and Use: Two companies in the United States produced refined cadmium in 2020. One company, operating in Tennessee, recovered primary refined cadmium as a byproduct of zinc leaching from roasted sulfide concentrates. The other company, operating in Ohio, recovered secondary cadmium metal from spent nickel-cadmium (NiCd) batteries. Domestic production and consumption of cadmium were withheld to avoid disclosing company proprietary data. Cadmium metal and compounds are mainly consumed for alloys, coatings, NiCd batteries, pigments, and plastic stabilizers. For the past 5 years, the United States has been a net importer of unwrought cadmium metal and cadmium metal powders and a net exporter of wrought cadmium products and cadmium pigments.

Salient Statistics—United States:	2016	2017	2018	2019	2020^e
Production, refined ¹	W	W	W	W	W
Imports for consumption:					
Unwrought cadmium and powders	240	274	273	385	190
Wrought cadmium and other articles (gross weight)	(2)	2	1	20	3
Cadmium waste and scrap (gross weight)	52	20	20	86	70
Exports:					
Unwrought cadmium and powders	157	223	41	32	6
Wrought cadmium and other articles (gross weight)	371	205	99	84	440
Cadmium waste and scrap (gross weight)	12	(2)	(2)	6	(2)
Consumption, reported, refined	W	W	W	W	W
Price, metal, annual average, ³ dollars per kilogram	1.34	1.75	2.89	2.67	2.30
Stocks, yearend, producer and distributor	W	W	W	W	W
Net import reliance ⁴ as a percentage of apparent consumption	<25	<25	<50	<50	<50

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 cadmium telluride (CdTe) solar panels.

Import Sources (2016–19):⁵ Australia, 23%; China, 19%; Canada, 17%; Germany, 13%; and other, 28%.

Tariff:	Item	Number	Normal Trade Relations
			12–31–20
	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 metal was produced in Asia, and leading global producers, in descending order of production, were China and the Republic of Korea, followed by Canada and Japan with approximately equal production. A smaller amount of secondary cadmium metal was recovered from recycling NiCd batteries. In India, a major primary cadmium plant was under construction that would have a capacity of 2,600 tons per year. Although detailed data on the global consumption of primary cadmium were not available, NiCd battery production was thought to have continued to account for most global cadmium consumption. Other end uses for cadmium and cadmium compounds included alloys, anticorrosive coatings, pigments, polyvinyl chloride (PVC) stabilizers, and semiconductors for solar cells and for radiation-detecting imaging equipment. A new use for cadmium being developed in 2020 was for extremely precise cadmium-based optical lattice clocks; these would operate at room temperature, unlike those currently in use that required cryogenic cooling.

CADMIUM

The average monthly cadmium price began 2020 averaging \$2.63 per kilogram in January and trended downward to about \$2.08 per kilogram in August. The decrease could be attributed to decreasing demand in India, in large part owing to the COVID-19 pandemic affecting economic activity, including a lockdown in India that extended from March 25 to May 3. As a major consumer of cadmium, India was an important driver behind cadmium prices in the spot market.

In 2020, a major United States-based CdTe thin-film solar-cell producer reached its full production rate after completing a new facility in Ohio, increasing the company's U.S. CdTe solar-cell manufacturing capacity to 1.8 gigawatts per year. A second company entered the market in 2020 with a 100-megawatt-per-year facility, also in Ohio. Innovation continued in the NiCd battery industry. A new line of compact cadmium batteries designed to compete with conventional lead-acid batteries in remote locations was introduced for manufacture in the United States. The batteries were lighter than the lead-acid batteries, had a longer expected service life of more than 20 years, and would use the existing lead-acid battery charging system, allowing a direct replacement.

World Refinery Production and Reserves:

	Refinery production		Reserves⁶
	<u>2019</u>	<u>2020^e</u>	
United States ¹	W	W	Quantitative estimates of reserves are not available. The cadmium content of typical zinc ores averages about 0.03%. See the Zinc chapter for zinc reserves.
Canada	1,803	1,800	
China	8,200	8,200	
Japan	2,000	1,800	
Kazakhstan	1,500	1,500	
Korea, Republic of	4,400	3,000	
Mexico	1,395	1,300	
Netherlands	1,100	1,100	
Peru	772	700	
Russia	900	900	
Other countries	<u>2,320</u>	<u>2,300</u>	
World total (rounded) ⁷	24,400	23,000	

World Resources:⁶ 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: Lithium-ion and nickel-metal hydride batteries can replace NiCd batteries in many applications. Except where the surface characteristics of a coating are critical (for example, fasteners for aircraft), coatings of zinc, zinc-nickel, aluminum, or tin 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 PVC applications. Amorphous silicon and copper-indium-gallium-selenide photovoltaic cells compete with cadmium telluride in the thin-film solar-cell market. Research efforts continued to advance new thin-film technology based on perovskite material as a potential substitute.

^eEstimated. W Withheld to avoid disclosing company proprietary data.

¹Cadmium metal produced as a byproduct of zinc refining plus metal from recycling.

²Less than ½ unit.

³Average free market price for 99.95% purity in 10-ton lots; cost, insurance, and freight; global ports. Source: Metal Bulletin.

⁴Defined as imports of unwrought metal and metal powders – exports of unwrought metal and metal powders + adjustments for industry stock changes.

⁵Includes data for the following Harmonized Tariff Schedule of the United States code: 8107.20.0000.

⁶See Appendix C for resource and reserve definitions and information concerning data sources.

⁷Excludes U.S. production.