

COBALT

(Data in metric tons of contained cobalt unless otherwise noted)

Domestic Production and Use: In 2021, the nickel-copper Eagle Mine in Michigan produced cobalt-bearing nickel concentrate, which was exported to Canada or overseas for processing. In Missouri, a company produced nickel-copper-cobalt concentrate from historic mine tailings and was building a hydrometallurgical processing plant near the mine site. Most U.S. cobalt supply consisted of imports and secondary (scrap) materials. Approximately six companies in the United States produced cobalt chemicals. An estimated 42% of the cobalt consumed in the United States was used in superalloys, mainly in aircraft gas turbine engines; 9% in cemented carbides for cutting and wear-resistant applications; 16% in various other metallic applications; and 33% in a variety of chemical applications. The total estimated value of cobalt consumed in 2021 was \$340 million.

<u>Salient Statistics—United States:</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021^e</u>
Production: ^e					
Mine	640	480	500	600	700
Secondary ¹	2,750	2,750	2,750	2,000	1,600
Imports for consumption	11,900	11,900	13,900	9,740	9,900
Exports	5,690	6,980	4,080	3,440	4,800
Consumption (includes secondary):					
Estimated ²	9,240	9,290	9,050	7,300	6,600
Apparent ³	8,950	7,680	12,500	8,500	6,700
Price, average, dollars per pound:					
U.S. spot, cathode ⁴	26.97	37.43	16.95	15.70	23
London Metal Exchange (LME), cash	25.28	32.94	14.88	14.21	22
Stocks, yearend:					
Industry ^{e, 2, 5}	1,020	1,060	1,090	950	950
LME, U.S. warehouse	160	130	102	82	50
Net import reliance ⁶ as a percentage of apparent consumption	69	64	78	76	76

Recycling: In 2021, cobalt contained in purchased scrap represented an estimated 24% of cobalt estimated consumption.

Import Sources (2017–20): Cobalt contained in metal, oxide, and salts: Norway, 20%; Canada, 16%; Japan, 13%; Finland, 11%; and other, 40%.

<u>Tariff:</u>	<u>Item</u>	<u>Number</u>	<u>Normal Trade Relations</u> <u>12–31–21</u>
	Cobalt ores and concentrates	2605.00.0000	Free.
	Chemical compounds:		
	Cobalt oxides and hydroxides	2822.00.0000	0.1% ad valorem.
	Cobalt chlorides	2827.39.6000	4.2% ad valorem.
	Cobalt sulfates	2833.29.1000	1.4% ad valorem.
	Cobalt carbonates	2836.99.1000	4.2% ad valorem.
	Cobalt acetates	2915.29.3000	4.2% ad valorem.
	Unwrought cobalt, alloys	8105.20.3000	4.4% ad valorem.
	Unwrought cobalt, other	8105.20.6000	Free.
	Cobalt mattes and other intermediate products;		
	cobalt powders	8105.20.9000	Free.
	Cobalt waste and scrap	8105.30.0000	Free.
	Wrought cobalt and cobalt articles	8105.90.0000	3.7% ad valorem.

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

Government Stockpile:⁷ See Lithium for statistics on lithium-cobalt oxide and lithium-nickel-cobalt-aluminum oxide.

<u>Material</u>	<u>Inventory</u> <u>as of 9–30–21</u>	<u>FY 2021</u>		<u>FY 2022</u>	
		<u>Potential</u> <u>acquisitions</u>	<u>Potential</u> <u>disposals</u>	<u>Potential</u> <u>acquisitions</u>	<u>Potential</u> <u>disposals</u>
Cobalt	302	—	—	—	—
Cobalt alloys, gross weight ⁸	11	50	—	50	—

COBALT

Events, Trends, and Issues: Global cobalt mine and refinery production were forecast to increase to record high levels in 2021. The increase in raw materials feed was mainly from increased production at existing operations, although new production and restarts at suspended operations also contributed to supply. Congo (Kinshasa) continued to be the world's leading source of mined cobalt, supplying more than 70% of world cobalt mine production. With the exception of production in Morocco and artisanally mined cobalt in Congo (Kinshasa), most cobalt is mined as a byproduct of copper or nickel. China was the world's leading producer of refined cobalt, most of which was produced from partially refined cobalt imported from Congo (Kinshasa). China was the world's leading consumer of cobalt, with more than 80% of its consumption being used by the rechargeable battery industry.

World Mine Production and Reserves: Reserves for multiple countries were revised based on Government or industry reports.

	Mine production		Reserves ⁹
	2020	2021 ^e	
United States	600	700	69,000
Australia	5,630	5,600	¹⁰ 1,400,000
Canada	3,690	4,300	220,000
China	2,200	2,200	80,000
Congo (Kinshasa)	98,000	120,000	3,500,000
Cuba	3,800	3,900	500,000
Indonesia	1,100	2,100	600,000
Madagascar	850	2,500	100,000
Morocco	2,300	2,300	13,000
Papua New Guinea	2,940	3,000	47,000
Philippines	4,500	4,500	260,000
Russia	9,000	7,600	250,000
Other countries	<u>7,640</u>	<u>6,600</u>	<u>610,000</u>
World total (rounded)	142,000	170,000	7,600,000

World Resources:⁹ Identified cobalt resources of the United States are estimated to be about 1 million tons. Most of these resources are in Minnesota, but other important occurrences are in Alaska, California, Idaho, Michigan, Missouri, Montana, Oregon, and Pennsylvania. With the exception of resources in Idaho and Missouri, any future cobalt production from these deposits would be as a byproduct of another metal. Identified world terrestrial cobalt resources are about 25 million tons. The vast majority of these resources are in sediment-hosted stratiform copper deposits in Congo (Kinshasa) and Zambia; nickel-bearing laterite deposits in Australia and nearby island countries and Cuba; and magmatic nickel-copper sulfide deposits hosted in mafic and ultramafic rocks in Australia, Canada, Russia, and the United States. More than 120 million tons of cobalt resources have been identified in polymetallic nodules and crusts on the floor of the Atlantic, Indian, and Pacific Oceans.

Substitutes: Depending on the application, substitution for cobalt could result in a loss in product performance or an increase in cost. The cobalt contents of lithium-ion batteries, the leading global use for cobalt, are being reduced; potential commercially available cobalt-free substitutes use iron and phosphorus. Potential substitutes in other applications include barium or strontium ferrites, neodymium-iron-boron alloys, or nickel-iron alloys in magnets; cerium, iron, lead, manganese, or vanadium in paints; cobalt-iron-copper or iron-copper in diamond tools; copper-iron-manganese for curing unsaturated polyester resins; iron, iron-cobalt-nickel, nickel, ceramic-metallic composites (cermets), or ceramics in cutting and wear-resistant materials; nickel-base alloys or ceramics in jet engines; nickel in petroleum catalysts; rhodium in hydroformylation catalysts; and titanium-base alloys in prosthetics.

^eEstimated. — Zero.

¹Estimated from consumption of purchased scrap.

²Includes reported data and U.S. Geological Survey estimates.

³Defined as secondary production + imports – exports + adjustments for Government and industry stock changes for refined cobalt.

⁴Source: Platts Metals Week. Cobalt cathode is refined cobalt metal produced by an electrolytic process.

⁵Stocks held by consumers and processors; excludes stocks held by trading companies and held for investment purposes.

⁶Defined as imports – exports + adjustments for Government and industry stock changes for refined cobalt.

⁷See Appendix B for definitions.

⁸Inventory is cobalt alloys; potential acquisitions are samarium-cobalt alloy; excludes potential disposals of aerospace alloys.

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

¹⁰For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 560,000 tons.