

COBALT

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

Domestic Production and Use: In 2016, a nickel-copper mine in Michigan produced cobalt-bearing nickel concentrate. Most U.S. cobalt supply comprised imports and secondary (scrap) materials. Six companies were known to produce cobalt chemicals. About 45% of the cobalt consumed in the United States was used in superalloys, mainly in aircraft gas turbine engines; 8% in cemented carbides for cutting and wear-resistant applications; 16% in various other metallic applications; and 31% in a variety of chemical applications. The total estimated value of cobalt consumed in 2016 was \$250 million.

Salient Statistics—United States:	2012	2013	2014	2015	2016^e
Production:					
Mine ^e	—	—	120	760	690
Secondary	2,160	2,160	2,200	2,750	2,700
Imports for consumption	11,100	10,400	11,300	11,400	11,900
Exports	3,760	3,850	4,500	3,830	4,200
Shipments from Government stockpile excesses ¹	—	—	—	—	—
Consumption:					
Reported (includes secondary)	8,660	8,090	8,560	8,780	8,900
Apparent ² (includes secondary)	9,540	8,650	8,710	10,300	10,400
Price, average, dollars per pound:					
U.S. spot, cathode ³	14.07	12.89	14.48	13.44	11.90
London Metal Exchange (LME), cash	13.06	12.26	14.00	12.90	11.50
Stocks, yearend:					
Industry	980	1,080	1,420	1,330	1,300
LME, U.S. warehouse	51	41	9	165	195
Net import reliance ⁴ as a percentage of apparent consumption	77	75	75	73	74

Recycling: In 2016, cobalt contained in purchased scrap represented an estimated 30% of cobalt reported consumption.

Import Sources (2012–15): Cobalt contained in metal, oxide, and salts: China, 18%; Norway, 14%; Finland, 10%; Japan, 9%; and other, 49%.

Tariff: Item	Number	Normal Trade Relations⁵ 12–31–16
Cobalt ores and concentrates	2605.00.0000	Free.
Chemical compounds:		
Cobalt oxides and hydroxides	2822.00.0000	0.1% ad val.
Cobalt chlorides	2827.39.6000	4.2% ad val.
Cobalt sulfates	2833.29.1000	1.4% ad val.
Cobalt carbonates	2836.99.1000	4.2% ad val.
Cobalt acetates	2915.29.3000	4.2% ad val.
Unwrought cobalt, alloys	8105.20.3000	4.4% ad val.
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 val.

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

Government Stockpile:

Stockpile Status—9–30–16⁶

Material	Inventory	Disposal Plan FY 2016	Disposals FY 2016
Cobalt	301	—	—
Lithium cobalt oxide	^e 0.145	—	—
Lithium nickel cobalt aluminum oxide	^e 0.089	—	—

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Events, Trends, and Issues: Congo (Kinshasa) continued to be the world's leading source of mined cobalt, supplying more than one-half 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. In 2016, global cobalt mine production decreased, mainly owing to lower production from nickel operations. Growth in world refined cobalt supply was forecast to increase at a lower rate than that of world cobalt consumption, which was driven mainly by strong growth in the rechargeable battery and aerospace industries. As a result, the global cobalt market was expected to shift from surplus to deficit. China was the world's leading producer of refined cobalt and the leading supplier of cobalt imports to the United States. Much of China's production was from ore and partially refined cobalt imported from Congo (Kinshasa); scrap and stocks of cobalt materials also contributed to China's supply. In 2015 and 2016, China's State Reserve Bureau purchased cobalt for its stockpile. China was the world's leading consumer of cobalt, with nearly 80% of its consumption being used by the rechargeable battery industry.

World Mine Production and Reserves: Reserves for Australia, Canada, New Caledonia, the Philippines, South Africa, the United States, and "Other countries" were revised based on company or Government reports.

	Mine production		Reserves ⁷
	2015	2016 ^e	
United States	^e 760	690	21,000
Australia	6,000	5,100	⁸ 1,000,000
Canada	6,900	7,300	270,000
China	7,700	7,700	80,000
Congo (Kinshasa)	63,000	66,000	3,400,000
Cuba	4,300	4,200	500,000
Madagascar	3,700	3,300	130,000
New Caledonia ⁹	3,680	3,300	64,000
Philippines	4,300	3,500	290,000
Russia	6,200	6,200	250,000
South Africa	3,000	3,000	29,000
Zambia	4,600	4,600	270,000
Other countries	<u>11,600</u>	<u>8,300</u>	<u>690,000</u>
World total (rounded)	126,000	123,000	7,000,000

World Resources: 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 manganese nodules and crusts on the floor of the Atlantic, Indian, and Pacific Oceans.

Substitutes: In some applications, substitution for cobalt would result in a loss in product performance. Potential substitutes include barium or strontium ferrites, neodymium-iron-boron, 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, cermets, or ceramics in cutting and wear-resistant materials; iron-phosphorous, manganese, nickel-cobalt-aluminum, or nickel-cobalt-manganese in lithium-ion batteries; nickel-based alloys or ceramics in jet engines; nickel in petroleum catalysts; and rhodium in hydroformylation catalysts.

^eEstimated. — Zero.

¹Cobalt metal. In 2014–16, the Defense Logistics Agency acquired cobalt-bearing battery precursor materials.

²The sum of U.S. net import reliance and secondary production, as estimated from consumption of purchased scrap.

³As reported by Platts Metals Week.

⁴Defined as imports – exports + adjustments for Government and industry stock changes for refined cobalt.

⁵Tariffs for certain countries and items may be eliminated under special trade agreements.

⁶See [Appendix B](#) for definitions.

⁷See [Appendix C](#) for resource and reserve definitions and information concerning data sources.

⁸For Australia, Joint Ore Reserves Committee-compliant reserves were about 480,000 tons.

⁹Overseas territory of France. One company reported zero reserves owing to recent nickel prices, although it continued to produce from that deposit.