



2019 Minerals Yearbook

MOLYBDENUM [ADVANCE RELEASE]

MOLYBDENUM

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In the United States, total mine production of molybdenum concentrate increased by 5% to 43,600 metric tons (t) of contained molybdenum in 2019 compared with 41,400 t in 2018 (table 1). World mine production of molybdenum concentrate increased by 3% to 294,000 t of contained molybdenum in 2019 compared with 285,000 t in 2018 (table 10). The U.S. share of world production was 15% in both 2018 and 2019. Reported U.S. consumption of primary molybdenum products, not including molybdenum concentrates, was slightly less in 2019 compared with that in 2018 (table 3). U.S. annual averages of monthly average prices decreased in 2019; molybdic oxide (MoO_3 , called MoX) decreased by 4% and ferromolybdenum (FeMo) slightly decreased, compared with their annual average prices in 2018.

Molybdenum is contained in various minerals, but only molybdenite (MoS_2) is suitable for the industrial production of marketable molybdenum products. Although molybdenum is marketed largely as FeMo or as roasted concentrates (MoX), published production data refer to mine production, which is the recoverable molybdenum content of raw concentrates. Depending upon the minerals contained in the ore body, mines can be grouped into primary mines, where the recovery of MoS_2 is the sole objective, or byproduct mines, where the recovery of copper-bearing ores is the primary objective and MoS_2 provides additional economic value.

U.S. molybdenum reserves were estimated to have been about 2.7 million metric tons (Mt) in 2019, about 15% of world molybdenum reserves. About 90% of U.S. reserves occur in large, low-grade porphyry molybdenum deposits mined or anticipated to be mined primarily for molybdenum and in porphyry copper deposits as an associated metal sulfide. These deposits are in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah.

Molybdenum is a refractory metallic element used principally as an alloying agent in cast iron, steel, and superalloys to enhance hardenability, strength, toughness, and wear- and corrosion-resistance. To achieve desired metallurgical properties, molybdenum, primarily in the form of MoX or FeMo, is commonly used in combination with or added to chromium, manganese, nickel, niobium (columbium), tungsten, or other alloy metals. The versatility of molybdenum in enhancing a variety of alloy properties has ensured it a significant role in contemporary industrial technology, which increasingly requires materials that can sustain high stress, expanded temperature ranges, and highly corrosive environments. Molybdenum is used extensively as a refractory metal and in numerous chemical applications, including catalysts, lubricants, and pigments. Molybdenum has become increasingly important in green technology, particularly in the manufacture of biofuels, catalysts, ethanol, solar panels, and wind turbines.

Production

Domestic primary and byproduct molybdenum mine production data were derived from three separate voluntary surveys by the U.S. Geological Survey: the annual “Molybdenum Ore and Concentrate” and monthly “Molybdenum Concentrate” and “Molybdenum Concentrates and Molybdenum Products” surveys. Surveys were sent to all nine U.S. operations (two primary molybdenum mines and seven byproduct mines) that produced molybdenum concentrates and products from ore in 2019, and all responded, representing 100% of U.S. molybdenum concentrate production reported in table 1.

Molybdenum concentrate production at primary molybdenum mines continued at two U.S. operations, accounting for 30% of total U.S. molybdenum concentrate production. Molybdenum concentrate production at byproduct mines continued at seven U.S. operations, accounting for 70% of total U.S. molybdenum concentrate production.

As of December 31, 2019, the rated capacity for mines and mills in the United States was estimated to be 88,500 metric tons per year (t/yr) of contained molybdenum. Rated capacity is defined as the maximum quantity of product that can be produced in a period of time on a normally sustainable long-term operating rate, based on the physical equipment of the plant and given acceptable routine operating procedures involving energy, labor, maintenance, and materials. Capacity included plants that were temporarily closed but could be brought into production within a short period of time with minimal capital expenditure.

Primary molybdenum production continued at the Climax and Henderson Mines in Colorado. Freeport-McMoRan Inc. (FCX) operated the Climax open pit mine and the Henderson underground mine. Both mines produced high-purity, chemical-grade molybdenum concentrates, which were further processed into value-added molybdenum chemical products. The Climax Mine restarted commercial operations in May 2012 and included a 25,000-metric-ton-per-day (t/d) mill facility. Climax had the capacity to produce approximately 13,600 t/yr of molybdenum. Molybdenum production from Climax totaled 7,710 t in 2019, a 19% decrease from the 9,530 t produced in 2018 (Freeport-McMoRan Inc., 2020, p. 13).

The Henderson Mine produced 5,440 t of molybdenum in 2019, a 14% decrease compared with the 6,350 t produced in 2018. The Henderson operation consisted of a large underground mining complex that fed a 32,000-t/d concentrator. Henderson had the capacity to produce 15,900 t/yr of molybdenum concentrate. Most of the molybdenum concentrate produced at Henderson was shipped to FCX’s Fort Madison, IA, processing facility (Freeport-McMoRan Inc., 2020, p. 13).

The Thompson Creek Mine in Idaho was placed on care-and-maintenance status in 2014 and did not produce any molybdenum in 2019. The Ashdown Mine in Nevada and the Questa Mine in New Mexico remained closed.

Thompson Creek Metals Co. Inc. (TCMC) continued to operate its metallurgical roasting facility in Langeloth, PA. The facility had the capacity to roast 16,300 t/yr of raw molybdenum concentrate and the capacity to process more than 4,000 t/yr of MoX into FeMo. The Langeloth facility also processed non-molybdenum catalysts for various customers, primarily in the food industry (Centerra Gold Inc., undated).

Byproduct mines included the Bagdad, Morenci, Pinto Valley, and Sierrita Mines in Arizona; the Continental Pit Mine in Montana; the Robinson Mine in Nevada; and the Bingham Canyon Mine in Utah (table 2). In the case of byproduct molybdenum recovery at a copper mine, all mining costs associated with molybdenum concentrate production were allocated to the primary metal (copper).

The Bagdad operation of FCX included an 81,600-t/d concentrator that produced copper and molybdenum concentrates, as well as a pressure-leach plant that processed molybdenum concentrate. Bagdad produced approximately 5,900 t of molybdenum concentrate in 2019 compared with 4,540 t in 2018 (Freeport-McMoRan Inc., 2020, p. 8).

The Morenci operation of FCX consisted of two concentrators capable of milling 132,000 t/d of ore to produce copper and molybdenum concentrates. FCX owned a 72% undivided interest in Morenci; the remaining interest was owned by Sumitomo Metal Mining Arizona, Inc. (15%) and SMM Morenci, Inc. (13%). Morenci's production, including the joint-venture partners' shares, totaled 2,270 t of molybdenum concentrate in 2019, compared with 4,080 t produced in 2018 (Freeport-McMoRan Inc., 2020, p. 7).

The Sierrita operation of FCX included a 100,000-t/d concentrator that produced copper and molybdenum concentrates. Sierrita also had molybdenum facilities consisting of a leaching circuit, two molybdenum roasters, and a packaging facility. The molybdenum facilities processed concentrate from Sierrita, other FCX mines, and third-party sources. The Sierrita operation produced 7,260 t of molybdenum concentrate in both 2018 and 2019 (Freeport-McMoRan Inc., 2020, p. 10).

Rio Tinto plc (United Kingdom) reported 2019 molybdenum concentrate production at its Bingham Canyon Mine (operated by its subsidiary Rio Tinto Kennecott) to be 11,200 t, a 93% increase compared with the 5,800 t produced in 2018. According to the company, the large molybdenum production increase was a result of both higher ore grades as well as plant capacity and productivity improvements (Rio Tinto plc, 2020, p. 272). Rio Tinto announced in December a \$1.5 billion investment that would extend operations at Kennecott through 2032 (Rio Tinto plc, 2019).

Montana Resources LLP continued molybdenum concentrate production at its Continental Pit Mine in Butte, MT. Capstone Mining Corp. (Canada) also continued molybdenum concentrate production at its Pinto Valley Mine near Miami, AZ. Capstone produced 106 t of molybdenum concentrate in 2019 compared with 117 t in 2018 (Capstone Mining Corp., 2020, p. 33). Robinson Nevada Mining Co., a wholly owned subsidiary of

KGHM International Ltd. (Poland), continued molybdenum production at its Robinson Mine in White Pine County, NV (KGHM Polska Miedź S.A. Group, 2020, p. 12).

There are many molybdenum mine development projects in different stages of advancement. In July, Hudbay Minerals Inc.'s (Canada) Rosemont copper project received a court ruling that blocked all construction, and the court remanded all of Rosemont's mining permits owing to environmental concerns. The company had already started preparing for construction at its \$122 million project in Arizona. Hudbay intended to appeal the court's ruling (Hudbay Minerals Inc., 2019).

American CuMo Mining Corp. (Canada) announced in December that it had filed a preliminary economic assessment for its CuMo project. The CuMo project is a copper-molybdenum-silver-rhenium deposit located in Boise County, ID. The project still required the completion of environmental permitting and prefeasibility analysis to advance (American CuMo Mining Corp., 2019).

Consumption

Statistics on consumption of molybdenum in end-use applications by U.S. metal consumers were developed from the voluntary "Consolidated Consumers Survey." For this survey, molybdenum consumers were canvassed on a monthly or annual basis. Reported consumption and stocks data in tables 1 and 3 include estimates to account for nonrespondents.

In 2019, reported U.S. consumption of molybdenum contained in concentrate for roasting increased compared with that in 2018. Reported consumption of molybdenum contained in concentrate was withheld to avoid disclosing company proprietary data (table 1). Domestic mine production of molybdenum in concentrate was roasted, exported for conversion, or purified to lubricant-grade MoS₂.

In 2019, reported U.S. consumption of molybdenum contained in concentrate for primary products such as alloys, carbon steel, and stainless steel was slightly less than that in 2018. MoX was the leading form of molybdenum used by industry, particularly in making stainless steel. Superalloy industry consumption of molybdenum products decreased in 2019 compared with that in 2018 (tables 1, 3).

Metallurgical applications dominated reported molybdenum use in 2019, accounting for approximately 88% of 2019 total reported consumption. In 2019, FeMo accounted for 17% of the molybdenum-bearing materials used to make steel (not including carbon and tool steel, for which data were withheld) (table 3). Nonmetallurgical applications included catalysts, chemicals, lubricants, and pigments. Catalytic applications, principally those related to petroleum refining, constituted the largest uses for molybdenum outside the steel industry and were the most important chemical end uses for molybdenum.

Stocks

At yearend 2019, consumer stocks increased compared with yearend 2018 stocks. Consumer stocks of molybdenum in FeMo, MoX, metal powders, and other products increased compared with stocks in 2018 (table 3). Data for inventories of molybdenum concentrate at mines and plants were withheld (table 1).

Prices

In 2019, the average monthly price for domestic MoX, as published by CRU Group, ranged from \$10.125 to \$12.644 per pound, compared with \$10.414 to \$13.225 per pound in 2018. In 2019, the average monthly price for domestic FeMo ranged from \$11.247 to \$13.500 per pound of contained molybdenum, compared with \$12.153 to \$14.075 per pound reported in 2018 (fig. 1). FeMo has historically commanded a small price premium over MoX as a result of the additional conversion costs incurred during production.

In the first half of 2019, MoX prices increased owing to strong demand from both the stainless steel and oil and gas industries. However, MoX prices decreased in July and continued to decrease for the remainder of the year. In the first 4 months of 2019, FeMo prices increased. However, FeMo prices decreased in May and continued to decrease for the remainder of the year.

Foreign Trade

Molybdenum was imported and exported as raw and roasted concentrates and FeMo. Exports of molybdenum ore and concentrates (both unroasted and roasted) totaled 64,100 t (molybdenum content) valued at \$1,090 million with 56% of this total going to the Netherlands (table 5). The Netherlands featured prominently in international trade of molybdenum concentrates and molybdenum-containing products, both as a transiting and warehouse location and as the location for one of Climax Molybdenum Co.'s processing facilities in Rotterdam. In 2019, U.S. imports of molybdenum ore and concentrates (both roasted and unroasted) totaled 20,500 t (molybdenum content), a 10% decrease from the 22,800 t imported in 2018 (table 9).

In 2019, molybdenum-containing exports (excluding molybdates and molybdenum ore and concentrates) collectively totaled 2,040 t (gross weight) valued at \$78 million (table 6). Imports for consumption of all molybdenum-containing products (excluding molybdates and molybdenum ore and concentrates) collectively totaled approximately 17,800 t (gross weight) valued at \$395 million (table 9).

World Review

World molybdenum reserves and production capacity were concentrated in a few countries. In 2019, world molybdenum mine output increased by 3% from that in 2018 to 294,000 t (molybdenum contained in concentrate), of which, in descending order of production, China, Chile, the United States, Peru, and Mexico accounted for 94% (table 10). According to the International Molybdenum Association, global molybdenum consumption in 2019 decreased to 258,000 t compared with 265,000 t in 2018 (International Molybdenum Association, 2020).

Argentina.—In March, Glencore International AG, Goldcorp Inc., and Yamana Gold Inc. announced that they had signed an integration agreement that would involve Yamana's copper-gold-silver-molybdenum Agua Rica project being developed and operated using the existing facilities of Minera Alumbrera Ltd. (Glencore, 50%; Newmont Corp., 37.5%; and Yamana, 12.5%) in the Catamarca Province of Argentina. The Catamarca Province approved a closure plan for the reclamation of the

Alumbrera Mine that all parties agreed upon (Yamana Gold Inc., 2019, p. 1–2).

Armenia.—Armenian Molybdenum Production LLC (AMP) continued to produce ferromolybdenum at its facility in Yerevan from molybdenum concentrates from Armenia, Chile, China, Peru, and Russia. AMP's facility had the capacity to produce 3,600 t/yr of ferromolybdenum (Armenian Molybdenum Production LLC, undated).

Canada.—In 2019, Canada produced an estimated 3,900 t of molybdenum in concentrate, a 23% decrease from the 5,100 t produced in 2018. In 2019, there were only two mines producing molybdenum in Canada: the Highland Valley Mine (Teck Resources Ltd.) and the Gibraltar Mine (Taseko Mines Ltd.). Production at the Endako Mine was suspended in 2015. Teck Resources Ltd. announced that its Highland Valley Mine in south-central British Columbia produced 2,990 t of molybdenum in concentrate in 2019, a 24% decrease from the 3,950 t produced in 2018. The company attributed the decrease primarily to lower ore grades. Production in 2020 was expected to be between 2,040 and 2,490 t of molybdenum in concentrate (Teck Resources Ltd., 2020, p. 17).

At its Gibraltar Mine in south-central British Columbia, Taseko Mines Ltd. produced 1,240 t of molybdenum in concentrate in 2019, an increase from the 1,070 t of molybdenum in concentrate produced in 2018. Taseko attributed the increase in production to improved processing (Taseko Mines Ltd., 2020).

Chile.—Chile was the world's second-leading producing country of mined molybdenum, behind China, and all of Chile's molybdenum production was produced as a byproduct of copper mining.

Amerigo Resources Ltd. (Canada) reported that it produced 635 t of molybdenum in 2019, compared with 861 t of molybdenum in 2018 at its Minera Valle Central (MVC) processing facility in central Chile. Amerigo processed mine tailings and completed the expansion of its operations to extend MVC's life to at least 2037 (Amerigo Resources Ltd., 2020, p. 7–9).

Antofagasta plc (United Kingdom) announced that 2019 byproduct molybdenum production at its 60%-owned Los Pelambres Mine was 11,200 t, a 16% decrease compared with 13,300 t produced in 2018. The company attributed the decreased production to a lower average ore grade compared with that in 2018. Antofagasta anticipated molybdenum production at the Los Pelambres Mine to be approximately 10,000 to 11,000 t of molybdenum in 2020. Antofagasta also announced that its new molybdenum plant at the 70%-owned Centinela Mine produced 400 t of molybdenum in concentrate in 2019. The Centinela molybdenum plant started production in the third quarter of 2018 and had a capacity to produce 2,400 t/yr of molybdenum in concentrate. The Centinela Mine is 1,350 kilometers (km) north of Santiago in the Antofagasta Region. The company expected Centinela to produce 2,500 to 3,000 t of molybdenum in concentrate in 2020 (Antofagasta plc, 2020, p. 57–59, 211).

Corporación Nacional del Cobre de Chile (CODELCO), the state-controlled copper and molybdenum producer, announced

that it produced 22,000 t of molybdenum in 2019 compared with 24,000 t in 2018 (Statista, 2020).

The Sierra Gorda project, in the Antofagasta Region in northern Chile, was a joint venture among KGHM International (55%); Sumitomo Metal Mining Co., Ltd. (Japan) (31.5%); and Sumitomo Corp. (Japan) (13.5%) under the operating company Sierra Gorda SCM. The Sierra Gorda Mine produced 9,210 t of molybdenum in concentrate in 2019, a 24% decrease from 12,100 t of molybdenum in concentrate produced in 2018. Despite the higher processing of ore, molybdenum production decreased as a result of the lower molybdenum content in the ore (KGHM Polska Miedź S.A. Group, 2020, p. 14, 64).

China.—China's molybdenum production took place predominantly in Hebei, Henan, and Shaanxi Provinces and the Inner Mongolia Autonomous Region. The three leading molybdenum mining companies were Jinduicheng Molybdenum Group Mining Corp., China Molybdenum Co., Ltd., and Yichun Luming Mining Co., Ltd. (Roskill Information Services Ltd., 2019). Most mine production in China was from primary mines. China had many small-scale mining operations that were susceptible to changes in prices but were able to quickly increase or decrease production during price fluctuations. China was the leading producer of molybdenum in 2019; however, reported production totals were inconsistent between sources owing to the large number of small-scale mining operations.

Mexico.—Southern Copper Corp. (a subsidiary of Grupo México S.A.B. de C.V.) reported that it produced 6,120 t of molybdenum in concentrate in 2019 at its Buenavista Mine, a 24% increase from 4,920 t in 2018. The Buenavista Mine is 40 km south of the (Arizona) United States–Mexico border. The Buenavista facility consisted of two molybdenum plants. The first molybdenum plant began production in 2013 with production capacity of 2,000 t/yr of molybdenum in concentrate. The plant was designed to process 1,500 t/d of copper-molybdenum concentrates with a recovery of approximately 50% molybdenum content in the processed concentrates. The second molybdenum plant began production in 2016 and was designed to process 3,040 t/d of copper-molybdenum concentrates with a recovery of 60% molybdenum content in the processed concentrates (Southern Copper Corp., 2020, p. 22, 27, 40–43).

Southern Copper reported that its La Caridad Mine, in northeastern Sonora, produced 10,200 t of molybdenum in concentrate in 2019 compared with 9,800 t in 2018. The molybdenum recovery plant had a capacity to process 2,000 t/d of copper-molybdenum concentrates (Southern Copper Corp., 2020, p. 43–45).

Peru.—Teck announced that it produced 3,540 t of molybdenum in concentrate in 2019 at the Antamina copper-zinc mine in Peru, 24% less than that in 2018. According to the company, copper, molybdenum, and zinc production at the Antamina Mine varied significantly from year to year owing to the geology of the deposit and proportion of copper to copper-zinc ore processed. The Antamina Mine is in the Andes Mountain range, 270 km north of Lima. The Antamina Mine was a joint venture among BHP Billiton plc (Australia; 33.75%), Glencore plc (Switzerland; 33.75%), Teck (Canada; 22.5%), and

Mitsubishi Corp. (Japan; 10%) (Wheaton Precious Metals Corp., 2018, p. 85; Teck Resources Ltd., 2020, p. 17).

The Cerro Verde Mine (FCX had a 53.56% ownership interest) is an open pit copper and molybdenum mining complex, 32 km southwest of Arequipa. According to FCX, production in 2019 was approximately 13,200 t of molybdenum in concentrate compared with 12,700 t in 2018 (Freeport-McMoRan Inc., 2020, p. 14).

Southern Copper produced 3,300 t of molybdenum in concentrate at its Cuajone operation in 2019 compared with 3,100 t in 2018. The Cuajone operation is in the southernmost region of the Andes Mountain range of Peru and molybdenum concentrate production began at its facility in 2016. Southern Copper produced 7,300 t of molybdenum in concentrate at its Toquepala operation in 2019 compared with 4,200 t of molybdenum in concentrate in 2018. The 73% increase in production was due in part to commissioning of a second concentrator in the fourth quarter of 2018. Toquepala is in the southernmost region of the Andes Mountains (Southern Copper Corp., 2020, p. 27, 33, 35).

Outlook

The principal uses for molybdenum are expected to continue to be in catalysts and chemicals and as an additive in steel manufacturing, most importantly alloy and stainless steel. Molybdenum plays a vital role in the energy industry and it may become an increasingly important factor in environmental protection technology, where it is used in high-strength steels for automobiles to reduce weight and improve fuel economy and safety. Molybdenum-based catalysts have a number of important applications in the petroleum and plastics industries. A major use is in the hydrodesulfurization of petroleum, petrochemicals, and coal-derived liquids. Catalysts are estimated to account for more than 70% of chemical uses of molybdenum (Roskill Information Services Ltd., 2017, p. A195). Molybdenum not only allows for economical fuel refining, but also is better for the environment through lower sulfur emissions. Analysts expect global demand for catalysts to continue to increase as there is no practical alternative to molybdenum in many of its catalytic applications (Roskill Information Services Ltd., 2017, p. 1–2). Analysts expect overall molybdenum production to remain relatively stagnant in 2020 owing to the fact that several major producers have either flat or decreased production levels anticipated for 2020.

The consumption of molybdenum in structural and engineering steel is forecast to remain the leading end use for molybdenum products (Roskill Information Services Ltd., 2019).

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GENERAL SOURCES OF INFORMATION

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TABLE 1
SALIENT MOLYBDENUM STATISTICS¹

(Metric tons, molybdenum content)

	2015	2016	2017	2018	2019
United States:					
Concentrate:					
Production	47,400	36,200	40,700	41,400	43,600
Shipments	50,500	38,600	40,400	42,600	43,600
Reported consumption ²	W	W	W	W	W
Imports for consumption	12,900	14,900	24,300	22,800 ^r	20,500
Exports	36,800	27,700	39,800	44,800	64,100
Primary products:					
Production	W	W	W	W	W
Shipments	W	W	W	W	W
Reported consumption	17,600	15,800	17,400	16,700 ^r	16,500
Imports for consumption	4,620	7,940	11,700	14,700	13,700
Exports	4,670	3,520	3,390	3,610 ^r	3,180
Stocks, December 31:					
Concentrate, mine and plant	W	W	W	W	W
Product producers ³	W	W	W	W	W
Consumers	1,880	1,910	2,010	1,940	1,980
Total	1,880	1,910	2,010	1,940	1,980
World, mine production	289,000 ^r	280,000 ^r	283,000 ^r	285,000 ^r	294,000

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

¹Table includes data available through July 27, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Molybdenum concentrates roasted to make molybdenum oxide.

³Includes ammonium, calcium, and sodium molybdate; briquets; ferromolybdenum; molybdenum hexacarbonyl; molybdenum metal; molybdenum pentachloride; molybdic acid; pellets; phosphomolybdic disulfide; and technical and purified molybdic oxide.

TABLE 2
MOLYBDENUM-PRODUCING MINES IN THE UNITED STATES IN 2019

State and mine	County	Operator	Source of molybdenum
Arizona:			
Bagdad	Yavapai	Freeport-McMoRan Inc.	Copper-molybdenum ore, concentrated.
Morenci	Greenlee	do.	Do.
Pinto Valley	Gila	Capstone Mining Corp.	Do.
Sierrita	Pima	Freeport-McMoRan Inc.	Do.
Colorado:			
Climax	Lake and Summit	do.	Molybdenum ore, concentrated.
Henderson	Clear Creek	do.	Do.
Montana, Continental Pit	Silver Bow	Montana Resources	Copper-molybdenum ore, concentrated.
Nevada, Robinson	White Pine	Robinson Nevada Mining Co. ¹	Do.
Utah, Bingham Canyon	Salt Lake	Rio Tinto Kennecott	Do.

Do., do. Ditto.

¹Wholly owned subsidiary of KGHM International Ltd.

TABLE 3
U.S. REPORTED CONSUMPTION, BY END USES, AND CONSUMER STOCKS OF MOLYBDENUM MATERIALS¹

(Kilograms, molybdenum content)

End use	Molybdic oxides	Ferromolybdenum ²	Ammonium and sodium molybdate	Molybdenum scrap	Other molybdenum products	Total
2018:						
Steel:						
Carbon	W	W	--	--	W	W
High-strength low-alloy	W	191,000	--	--	W	191,000
Stainless and heat-resisting	2,220,000 ^r	682,000 ^r	--	(3)	109,000	3,010,000 ^r
Full alloy	3,310,000	1,260,000	--	--	W	4,570,000 ^r
Tool	W	W	--	(3)	--	W
Total	5,530,000 ^r	2,130,000	--	(3)	109,000	7,770,000 ^r
Cast irons (gray, malleable, ductile iron)	W	W	--	--	W	W
Superalloys	W	--	--	(3)	1,070,000	1,070,000
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	W	--	--	W	W
Other alloys	1,200	47,400	--	--	W	48,600
Mill products made from metal powder ⁴	--	--	--	--	W	W
Cemented carbides and related products ⁵	--	--	--	--	77	77
Chemical and ceramic uses:						
Pigments	W	--	(3)	--	--	W
Catalysts	W	--	(3)	--	W	W
Other	--	--	--	--	W	W
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	152,000	152,000
Other	2,710,000 ^r	878,000 ^r	5,110	(6)	4,100,000 ^r	7,700,000 ^r
Grand total	8,240,000 ^r	3,060,000	5,110	(6)	5,430,000 ^r	16,700,000 ^r
Stocks, December 31	641,000	377,000	6,250	(6)	(6)	1,940,000
2019:						
Steel:						
Carbon	W	W	--	--	W	W
High-strength low-alloy	W	191,000	--	--	W	191,000
Stainless and heat-resisting	2,200,000	692,000	--	(3)	111,000	3,000,000
Full alloy	3,200,000	1,050,000	--	--	W	4,250,000
Tool	W	W	--	(3)	--	W
Total	5,400,000	1,930,000	--	(3)	111,000	7,440,000
Cast irons (gray, malleable, ductile iron)	W	W	--	--	W	W
Superalloys	W	--	--	(3)	992,000	992,000
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	W	--	--	W	W
Other alloys	1,190	44,000	--	--	W	45,200
Mill products made from metal powder ⁴	--	--	--	--	W	W
Cemented carbides and related products ⁵	--	--	--	--	W	W
Chemical and ceramic uses:						
Pigments	W	--	(3)	--	--	W
Catalysts	W	--	(3)	--	W	W
Other	--	--	--	--	W	W
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	152,000	152,000
Other	2,710,000	893,000	5,110	(6)	4,210,000	7,820,000
Grand total	8,110,000	2,870,000	5,110	(6)	5,470,000	16,500,000
Stocks, December 31	653,000	390,000	3,690	(6)	(6)	1,980,000

¹Revised. W Withheld to avoid disclosing company proprietary data; included in "Miscellaneous and unspecified uses: Other." -- Zero.

¹Table includes data available through July 27, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes calcium molybdate.

³Withheld to avoid disclosing company proprietary data; included in "Other molybdenum materials: Miscellaneous and unspecified uses: Other."

⁴Includes ingot, wire, rod, and sheet.

⁵Includes construction, mining, oil and gas, and metal working machinery.

⁶Withheld to avoid disclosing company proprietary data; included in "Total."

TABLE 4
U.S. EXPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY OR LOCALITY¹

(Metric tons, gross weight, and thousand dollars)

Product and country or locality	HTS ² code	2018		2019	
		Quantity	Value	Quantity	Value
Oxides and hydroxides: ³	2825.70.0000				
Brazil		36	753	45	962
Canada		170	2,110	49	657
Estonia		--	--	40	842
France		(4)	3	10	269
Germany		14	217	9	132
India		27	421	57	887
Japan		81	1,600	34	698
Mexico		84	1,410	83	1,630
Netherlands		156	3,530	80	1,680
Turkey		210	4,320	98	2,290
Other [12 countries and (or) localities]		95 ^r	873 ^r	20	413
Total		874	15,200	524	10,500
Molybdates, all (contained weight): ⁵	2841.70.0000				
Canada		306	3,930	437	4,730
China		192	2,390	227	2,020
Germany		14	470	78	1,530
Japan		65	975	166	2,780
Netherlands		369	4,300	409	5,130
Other [36 countries and (or) localities]		357 ^r	6,540 ^r	165	2,880
Total		1,300	18,600 ^r	1,480	19,100
Ferromolybdenum: ^{5,6}	7202.70.0000				
Australia		3	68	2	43
Canada		452 ^r	9,160 ^r	243	4,770
China		--	--	1	33
Denmark		1	37	1	47
Mexico		513	9,930	306	5,950
Other [3 countries and (or) localities]		(4)	11	(4)	6
Total		972 ^r	19,200 ^r	554	10,800
Molybdenum, other: ^{3,7}	Various ⁸				
Canada		77	2,660	75	3,140
China		81	5,860	67	6,200
Germany		107	5,960	116	5,940
India		21	1,190	28	1,570
Israel		42	3,320	26	2,180
Japan		111	5,370	50	4,000
Korea, Republic of		107	8,790	70	5,720
Netherlands		3	288	46	1,550
Taiwan		98	5,580	61	4,180
United Kingdom		200	7,270	274	10,500
Other [31 countries and (or) localities]		167 ^r	8,090 ^r	146	9,560
Total		1,010	54,400	960	54,500

^rRevised. -- Zero.

¹Table includes data available through July 12, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States (HTS).

³Presentation of annual data is based on the quantities (gross weight) of the 10 leading countries and (or) localities in 2019.

⁴Less than ½ unit.

⁵Presentation of annual data is based on the quantities (gross weight) of the five leading countries and (or) localities in 2019.

⁶Ferromolybdenum contains 60% to 65% molybdenum.

⁷Includes powder, unwrought, waste and scrap, wire, wrought, and other.

⁸Includes HTS codes 8102.10.0000, 8102.94.0000, 8102.95.0000, 8102.96.0000, 8102.97.0000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 5
U.S. EXPORTS OF MOLYBDENUM ORE AND CONCENTRATES
(INCLUDING ROASTED AND UNROASTED CONCENTRATES), BY COUNTRY OR LOCALITY^{1,2}
(Metric tons, molybdenum content, and thousand dollars)

Country or locality	2018		2019	
	Quantity	Value	Quantity	Value
Belgium	5,080	99,800 [†]	6,630	148,000
Brazil	27	281	16	366
Canada	1,390	23,000	1,110	18,000
China	1,040	24,200	529	9,330
Japan	3,920	95,900	3,970	99,100
Korea, Republic of	538	13,400	3,030	67,900
Mexico	1,880	28,700	3,050	46,800
Netherlands	21,100	378,000	35,900	540,000
Thailand	60	1,010	1,380	14,000
United Kingdom	6,710	152,000	7,550	129,000
Other [20 countries and (or) localities]	3,080 [†]	60,000 [†]	884	16,200
Total	44,800	877,000 [†]	64,100	1,090,000

[†]Revised.

¹Table includes data available through July 12, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Presentation of annual data is based on the quantities (molybdenum content) of the 10 leading countries and (or) localities in 2019.

Source: U.S. Census Bureau.

TABLE 6
U.S. EXPORTS OF MOLYBDENUM PRODUCTS¹

Item	HTS ² code	2018			2019		
		Quantity (metric tons)		Value (thousands)	Quantity (metric tons)		Value (thousands)
		Gross weight	Molybdenum content		Gross weight	Molybdenum content	
Molybdenum ore and concentrates:							
Roasted	2613.10.0000	NA	18,300	\$397,000	NA	28,500	\$532,000
Unroasted	2613.90.0000	NA	26,500	479,000	NA	35,500	556,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	874	NA	15,200	524	NA	10,500
Molybdates, all	2841.70.0000	NA	1,300	18,400	NA	1,480	19,100
Ferromolybdenum	7202.70.0000	943	678 [†]	18,400	552	387	10,800
Molybdenum powders	8102.10.0000	140	NA	6,660	111	NA	5,520
Molybdenum unwrought, bars and rods	8102.94.0000	67	NA	2,130	14	NA	754
Molybdenum waste and scrap	8102.97.0000	255	NA	5,520	277	NA	8,700
Molybdenum wire	8102.96.0000	5	NA	371	4	NA	416
Molybdenum, other	Various ³	548	NA	39,700	553	NA	41,300
Total		XX	XX	983,000	XX	XX	1,190,000

[†]Revised. NA Not available. XX Not applicable.

¹Table includes data available through July 12, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States (HTS).

³Includes HTS codes 8102.95.0000 and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY OR LOCALITY¹

(Metric tons, gross weight, and thousand dollars)

Product and country or locality	HTS ² code	2018		2019	
		Quantity	Value	Quantity	Value
Oxides and hydroxides: ³	2825.70.0000				
Chile		2,590	53,200	2,230	46,000
China		307	6,110	1,290	28,500
Germany		18	461	23	254
Korea, Republic of		545	9,700	449	8,360
Netherlands		--	--	261	5,330
Other [5 countries and (or) localities]		(4)	67 ^r	44	817
Total		3,460	69,500	4,290	89,300
Molybdates, all: ³	Various ⁵				
Chile		822	14,500	1,050	18,000
China		901 ^r	15,000	333	5,980
India		316	3,750	184	244
Japan		44	511	10	138
Netherlands		(4)	6	21	263
Other [8 countries and (or) localities]		50 ^r	1,080 ^r	14	351
Total		2,130 ^r	34,800	1,620	24,900
Molybdenum orange: ³	3206.20.0020				
Canada		146	1,430	131	1,130
China		1	7	--	--
Colombia		39	182	4	20
Germany		(4)	9	--	--
India		497	1,010	99	193
Total		683	2,630	234	1,350
Ferromolybdenum: ^{3,6}	7202.70.0000				
Belgium		51	991	91	1,930
Canada		571	9,960	41	658
Chile		7,600	146,000	5,200	99,600
Korea, Republic of		3,430 ^r	63,000	4,790	88,300
United Kingdom		85 ^r	816	197	3,520
Other [7 countries and (or) localities]		150 ^r	2,870 ^r	97	1,940
Total		11,900	223,000	10,400	196,000
Other: ⁷	Various ⁸				
Austria		684	28,900	685	29,300
Canada		360	8,210 ^r	401	11,400
China		981	32,900	836	32,300
Germany		406	14,800	382	13,300
Hong Kong		66	1,860	42	1,170
Korea, Republic of		7	264	28	853
Russia		31	1,090	68	2,520
Taiwan		3	236	42	1,370
United Kingdom		417	13,300	328	10,800
Uzbekistan		--	--	50	1,930
Other [19 countries and (or) localities]		80 ^r	3,980 ^r	78	3,100
Total		3,040	106,000	2,940	108,000

^rRevised. -- Zero.

¹Table includes data available through July 12, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States (HTS).

³Presentation of annual data is based on the quantities (gross weight) of the five leading countries and (or) localities in 2019.

⁴Less than ½ unit.

⁵Includes HTS codes 2841.70.1000 and 2841.70.5000.

⁶Ferromolybdenum contains 60% to 65% molybdenum.

⁷Presentation of annual data is based on the quantities (gross weight) of the 10 leading countries and (or) localities in 2019.

⁸Includes HTS codes 8102.10.0000, 8102.94.0000, 8102.95.3000, 8102.95.6000, 8102.96.0000, 8102.97.0000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS OF MOLYBDENUM ORE AND CONCENTRATES (INCLUDING
ROASTED AND UNROASTED CONCENTRATES), BY COUNTRY OR LOCALITY¹

(Metric tons, molybdenum content, and thousand dollars)

Country or locality	2018		2019	
	Quantity	Value	Quantity	Value
Canada	2,820	66,700	2,660	63,200
Chile	3,640	90,500	3,070	76,700
China	(2)	13	--	--
Japan	(2)	4	1	21
Mexico	2,750 ^r	62,500 ^r	2,960	60,000
Peru	13,600	363,000	11,800	330,000
South Africa	(2)	4	--	--
Total	22,800 ^r	582,000 ^r	20,500	530,000

^rRevised. -- Zero.

¹Table includes data available through July 12, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. IMPORTS FOR CONSUMPTION OF MOLYBDENUM PRODUCTS¹

Item	HTS ² code	2018			2019		
		Quantity (metric tons)		Value (thousands)	Quantity (metric tons)		Value (thousands)
		Gross weight	Molybdenum content		Gross weight	Molybdenum content	
Molybdenum ore and concentrates:							
Roasted	2613.10.0000	7,010 ^r	4,320 ^r	\$102,000	6,490	4,050	\$89,800
Unroasted	2613.90.0000	38,200	18,500	481,000	34,400	16,500	440,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	3,460	NA	69,500	4,290	NA	89,300
Molybdates, all	Various ³	2,130	1,140	34,800	1,620	874	27,000
Molybdenum orange	3206.20.0020	683	NA	2,630	234	NA	1,350
Ferromolybdenum	7202.70.0000	11,900	8,010	223,000	10,400	6,990	196,000
Molybdenum powders	8102.10.0000	410	386	15,000	238	221	8,520
Molybdenum unwrought, bars and rods	8102.94.0000	722	721	21,000	595	593	19,300
Molybdenum waste and scrap	8102.97.0000	1,700	1,580	48,900	1,900	1,750	59,700
Molybdenum wire	8102.96.0000	31	NA	3,030	18	NA	2,150
Molybdenum, other	Various ⁴	177	NA	17,500	193	NA	18,300
Total		66,400	XX	1,020,000	60,300 ^r	XX	951,000

^rRevised. NA Not available. XX Not applicable.

¹Table includes data available through July 12, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States (HTS).

³Includes HTS codes 2841.70.1000 and 2841.70.5000.

⁴Includes HTS codes 8102.95.3000, 8102.95.6000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 10
MOLYBDENUM: WORLD MINE PRODUCTION, BY COUNTRY OR LOCALITY¹

(Metric tons, molybdenum content)

Country or locality ²	2015	2016	2017	2018	2019
Argentina	1,736 ^r	2,048 ^r	1,297 ^r	728 ^r	--
Armenia	6,300	5,771	5,038	5,422 ^r	5,000 ^e
Canada	2,505	2,783	4,765	5,048 ^r	3,896
Chile	52,398	55,834	62,454	60,248	56,000 ^e
China	135,000	129,000	117,000 ^r	120,000 ^{r,e}	130,000 ^e
Iran	3,500	3,500 ^e	3,500 ^e	3,500 ^e	3,500 ^e
Korea, Republic of	259	--	--	--	--
Mexico	12,279	11,896	13,985	15,149	16,639
Mongolia	2,557	2,444	1,800	1,800	1,800 ^e
Peru	20,153	25,757	28,141	28,034	30,441
Russia	3,254	3,359	3,227 ^r	2,400 ^r	2,800 ^e
Turkey	900	900 ^e	900 ^e	900 ^e	400 ^e
United States	47,400	36,200	40,700	41,400	43,600
Uzbekistan	450 ^e	205	203	200 ^e	200 ^e
Total	289,000 ^r	280,000 ^r	283,000 ^r	285,000 ^r	294,000

^eEstimated. ^rRevised. -- Zero.

¹Table includes data available through June 1, 2020. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Bulgaria and Kyrgyzstan may have produced molybdenum, but available information was inadequate to make reliable estimates of output.

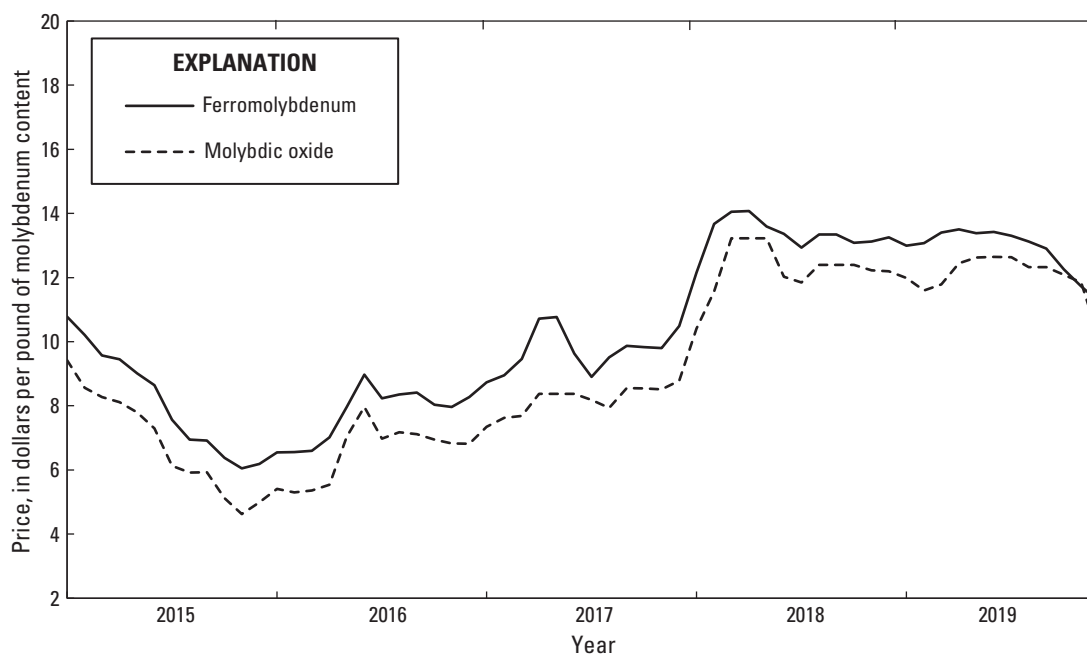


Figure 1. U.S. average monthly prices for ferromolybdenum and molybdic oxide from January 2015 through December 2019. Source: CRU Group.