



# 2008 Minerals Yearbook

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## MOLYBDENUM

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In the United States, mine production of molybdenum concentrate in 2008 decreased by 1,110 metric tons (t) to 55,900 t from that of 2007 (table 1). World mine production of molybdenum in 2008 was about 218,000 t, a slight increase from the 213,000 t (revised) in 2007. The U.S. share of world production was about 26% in 2008. Net U.S. production of molybdenum products increased to 33,400 t in 2008 from 31,100 t in 2007 (table 2). Reported 2008 U.S. consumption of molybdenum concentrate for roasting was 44,000 t, a slight increase compared with that of 2007.

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 molybdc oxide ( $\text{MoO}_3$ , called MoX) or ferromolybdenum (FeMo), is frequently 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. Moreover, molybdenum finds significant use as a refractory metal and in numerous chemical applications, including catalysts, lubricants, and pigments.

U.S. molybdenum reserves were estimated to be about 2.7 million metric tons (Mt), about 31% of the 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 as an associated metal sulfide in low-grade porphyry copper deposits. These deposits are located in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah. Other molybdenum sources contribute insignificantly to U.S. reserves.

## Production

Domestic molybdenum production data were derived from three separate voluntary surveys by the U.S. Geological Survey. These surveys are “Molybdenum Ore and Concentrate” (annual), “Molybdenum Concentrate” (monthly), and “Molybdenum Products and Molybdenum Concentrates” (monthly). Surveys were sent to all 12 U.S. operations that produce molybdenum concentrates and products from ore, and all responded, representing 100% of the U.S. production listed in table 1.

As of December 31, 2008, U.S. rated capacity for mines and mills was estimated to be about 73,400 metric tons per year (t/yr) of contained metal. Rated capacity was defined as

the maximum quantity of product that could be produced in a period of time at 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 operating plants temporarily closed and could be brought into production within a short period of time with minimal capital expenditure.

Primary molybdenum production continued at the Henderson Mine in Colorado, the Questa Mine in New Mexico, and the Thompson Creek Mine in Idaho. Golden Phoenix Minerals Inc. announced in November that its Ashdown molybdenum mine in Humboldt County, NV, was placed on care and maintenance with a significant reduction in force until further notice. The Ashdown Mine maintenance focused on restoring air, ventilation, and water utilities during summer 2008 and new mine equipment was received. During the maintenance period, the mill continued to operate (Golden Phoenix Minerals Inc., 2008).

In November, Freeport McMoRan Copper and Gold Inc. (FCX) announced revised mine plans at its Henderson Mine, which were expected to result in a 25% reduction of annual molybdenum production. FCX announced plans to defer restarting the Climax molybdenum mine in 2010. Once a decision is made to resume construction activities, the project would be capable of starting up within a 12- to 18-month timeframe (Freeport McMoRan Copper and Gold Inc., 2008, p. 5–6).

Thompson Creek Metals Company Inc. (TCMC) owns the Thompson Creek open pit molybdenum mine and mill in Idaho, a metallurgical roasting facility in Langeloth, PA, and a 75% share of the Endako open pit mine, mill, and roasting facility in northern British Columbia, Canada. TCMC has two high-grade underground molybdenum deposits, the Davidson deposit near Smithers, British Columbia, and the Mount Emmons deposit near Crested Butte, CO. TCMC announced that its mining operations continued to perform well in the fourth quarter with total molybdenum production rising by 20% to 3,500 t [7.8 million pounds (Mlb)] from 2,900 t (6.5 Mlb) in the third quarter. Production in 2008 was a record 11,800 t (26 Mlb), up by 59% from 7,400 t (16.4 Mlb) in 2007. Cash costs in 2008 averaged \$6.01 per pound produced in the fourth quarter and \$7.54 per pound produced during the full year (Thompson Creek Metals Company Inc., 2009).

Molybdenum was produced as a byproduct of copper production at the Bagdad, Mineral Park, Mission, Morenci, and Sierrita Mines in Arizona; the Continental Pit in Montana; the Chino Mine in New Mexico; and the Bingham Canyon Mine in Utah (table 10). At almost every byproduct mine there was

either a decrease or suspension of production during the fourth quarter in response to the sharp decline in molybdenum prices.

In the case of byproduct molybdenum recovery at a copper mine, all mining costs associated with producing the molybdenum concentrate are allocated to the primary metal (copper). Owing to this cost advantage, byproduct molybdenite recovery at selected porphyry copper mines was estimated to account for about 53% of the U.S. molybdenum supply in 2008. The 4% decrease from that of 2007 was mainly attributed to the 27% decrease in byproduct molybdenum production of Kennecott Utah Copper.

In November, FCX announced cutbacks in molybdenum production at the Bagdad, Morenci, and Sierrita Mines. FCX also called off expansion plans at Bagdad and Sierrita. FCX had originally planned to convert Bagdad's copper concentrate leach facility into a molybdenum concentrate leach facility by 2010 (Moly Investing News, 2008). FCX had four additional molybdenum processing facilities at Green Valley, AZ; Fort Madison, IA; Stowmarket, United Kingdom; and Rotterdam, Netherlands.

Rio Tinto plc announced that molybdenum concentrate production at its Bingham Canyon Mine operated by Kennecott Utah Copper was 19,400 t compared with 26,600 t in 2007. The decrease in molybdenum production was attributed to a 17% decrease in molybdenum content of ore compared with the previous year. The company plans to strip waste rock on the east side of the pit, which was expected to bring deliveries of higher grade ore forward to compensate for the declines in ore grades expected in 2011 and 2012. Rio Tinto also announced that the construction of the molybdenum autoclave process (MAP) facility approved during the second quarter of 2008 was delayed owing to falling molybdenum prices. The MAP was expected to enable lower-grade concentrate to be processed more efficiently than in conventional roasters, allow improved molybdenum recovery, and enable production of chemical grade molybdenum products (Metals Place, 2008a; Rio Tinto plc, 2008, p. 25, 28).

In November, General Moly Inc. announced that it was confident that the Mount Hope project in central Nevada would continue on track to be fully permitted and financed in time for a late 2010 startup, despite the decrease in molybdenum prices. The company finalized a basic engineering update, which was expected to take into account the decrease in commodity prices. According to the company, the Mount Hope project is one of the largest, highest grade, and most valuable undeveloped molybdenum projects in the world, containing 1.3 billion pounds of molybdenum in proven and probable reserves. General Moly currently owns 80% of the project through Eureka Moly LLC., (a joint venture with POSCO, one of the world's largest steel companies based in the Republic of Korea). In its update, General Moly anticipated the ability to access higher grades earlier in the mine plan, which has increased annual anticipated production to approximately 18,000 t/yr on average during the first 5 years of production (General Moly Inc., 2008).

The Liberty project is General Moly's second molybdenum property, located in Nye County, NV. In April, the company completed a prefeasibility study on the property that anticipated average production of 8,600 t/yr during its first 5 years of production. Total life of mine production was expected to be

228,000 t during a 33-year mine life. Total capital requirements were anticipated to be approximately \$500 million. Previous mining at the project was expected to help lower capital costs because existing usable infrastructure already existed. Additionally, the project is on private land, which was expected to allow for a shorter and simpler permitting process (General Moly Inc., 2009).

Mercator Minerals Ltd. announced in December that its new 25,000-metric-ton-per-day mill had started producing copper and molybdenum concentrates at the Mineral Park Mine in Arizona. Construction was performed in two stages with approximately 70% of Stage 2 mill expansion completed. The mine was expected to produce about 4,700 t/yr of molybdenum in concentrate for the first 10 years of its 25-year mine life (Mercator Minerals Ltd., 2008).

## Consumption

In 2008, the United States consumed 44,000 t of molybdenum contained in concentrate for roasting, an increase of about 100 t compared with that of 2007 (table 1). Domestic mine production of molybdenum concentrate was roasted, exported for conversion, or purified to lubricant-grade molybdenum disulfide ( $\text{MoS}_2$ ). Technical-grade MoX consumption in 2008 was slightly more than that of 2007. MoX was the leading form of molybdenum used by industry, particularly in making stainless steel. Overall, total steel use in 2008 increased by 6% from that of 2007, and total superalloy consumption decreased in 2008 by 17% from that of 2007 (table 3).

Metallurgical applications dominated molybdenum use in 2008, accounting for about 88% of total reported consumption (table 3). In 2008, FeMo accounted for 39% of the molybdenum-bearing materials used to make steel. Nonmetallurgical applications included catalysts, chemicals, lubricants, and pigments. The dominant nonmetallurgical use was in catalysts.

Molybdenum demand from catalyst makers increased in the first two quarters of 2008 owing to increased use of hydroprocessing catalysts as well as the increase in the molybdenum content in the catalysts. Molybdenum demand for nuclear reactor construction also significantly increased in 2008. There were 48 nuclear reactors planned to be built by 2013, and approximately 100 were to be built by 2020. The average reactor contains a large quantity of stainless steel alloy products containing molybdenum. In addition, most nuclear powerplants in the United States are more than 30 years old and are within only a few years of needing major repairs (Metals Place, 2008d).

Molybdenum is playing a larger role in green technology than ever before, focusing on use in biofuels and ethanol, solar panels, and wind power. Analysts anticipated that global ethanol and biofuel production would increase at nearly 15% annually through 2016. Owing to the corrosive nature of these fuels, molybdenum-bearing steels were expected to play a critical role in production plants, including use in boilers, cooling towers, process pipes, pumps, and reactors. Transportation of these fuels represent a possible new application for molybdenum because existing oil and gas pipelines cannot be used with ethanol. Therefore, construction of a new set of molybdenum-bearing

pipelines and tanker trucks may need to be built (General Moly Inc., 2008).

A new type of solar panel, copper indium gallium selenide (CIGS) cells, utilizes molybdenum in a thin layer near the bottom of the cell. The molybdenum helps to transfer the electricity generated from the solar cell to circuits external to the panel. Although photovoltaic solar power capacity is still small, CIGS technology has demonstrated the highest conversion efficiency and the longest product life within the solar industry. Analysts estimate that CIGS cells utilize approximately 1,100 t of molybdenum per gigawatt of capacity (General Moly Inc., 2008).

Global wind power production increased to 94 gigawatts (GW) in 2007 from 74 GW in 2006 and analysts expected a similar increase in 2008. Although wind turbines vary by size and by manufacturer, analysts estimated 140 t of steel was required per megawatt of electrical power produced on average. If one-half of the steel used in a conventional turbine contained molybdenum, approximately 4,000 t of molybdenum would have been consumed globally just for wind power generation in 2007. Turbine producers used molybdenum grade steels in offshore turbines to protect against corrosion and may also benefit from using molybdenum-grade steels in onshore turbines as they seek to reduce weight and improve efficiencies (General Moly Inc., 2008).

## Stocks

At yearend 2008, producer plus consumer industry stocks contained 5,465 t of molybdenum, an increase of 453 t compared with yearend 2007 stocks. Inventories of molybdenum in concentrate at mines and plants increased by about 860 t. Producer stocks of molybdenum in FeMo, molybdates, MoX, metal powders, and other products increased by about 710 t compared with those of 2007 (table 2). Total stocks of about 7,230 t represented about a 21-week supply. Supply was calculated as reported stocks divided by annual consumption (table 1).

## Prices

Prices were reported in Platts Metals Week in dollars per kilogram of contained molybdenum. The annual time-average prices for 2008 were \$62.988 per kilogram and \$69.665 per kilogram of contained molybdenum for MoX and FeMo, respectively, which represented decreases of 6% and 8%, respectively, compared with 2007 prices. Molybdenum prices rose steadily from January through August, when they reached their highest point at \$74.957 per kilogram for MoX and \$81.020 per kilogram for FeMo. From September through December prices decreased rapidly to close the year at \$20.944 per kilogram for MoX and \$25.353 per kilogram for FeMo. The MoX monthly average price ranged from a high of \$74.604 per kilogram in August to a low of \$21.164 per kilogram in December. The FeMo monthly average price ranged from a high of \$79.146 per kilogram in August to a low of \$26.676 per kilogram in December.

## Foreign Trade

In 2008, molybdenum-containing material exports collectively contained about 34,000 t of molybdenum and were valued at \$2.54 billion (table 6). Imports for consumption of molybdenum-containing products collectively contained about 13,700 t of molybdenum and were valued at \$814 million (table 9).

## World Review

World molybdenum reserves and production capacity were concentrated in a few countries. World mine output in 2008 was estimated to be 218,000 t (molybdenum contained in concentrate), of which, in descending order of production, China, the United States, Chile, Peru, and Canada provided about 90% (table 11). Chile, China, and the United States also held about 83% of the estimated 8.6 Mt of world molybdenum reserves.

In North America, most Canadian reserves of molybdenum were contained in porphyry molybdenum and porphyry copper-molybdenum deposits in British Columbia. Other Canadian reserves were associated with minor porphyry copper-molybdenum deposits in New Brunswick and Quebec. The La Caridad porphyry copper-molybdenum deposit in Mexico was a leading producer. Molybdenum reserves in Central America and South America were associated mainly with large porphyry copper deposits. Of several such deposits in Chile, the Chuquicamata and El Teniente deposits were among the world's largest and accounted for 85% of molybdenum reserves in Chile. Peru also had substantial reserves. Reserves of molybdenum in China and the Commonwealth of Independent States (CIS) were thought to be substantial, but definitive information about the current sources of supply or prospects for future development in these two areas was lacking.

**Armenia.**—In August, Germany's Cronimet Mining GmbH announced that it would intensify efforts to develop additional transport routes that would allow flexibility in the transport of FeMo if transportation became a problem owing to conflict between Georgia and Russia. Cronimet manages Zangezur Copper and Molybdenum Combine AG (ZCMC), which operates the Karajan copper-molybdenum mine, the largest molybdenum-bearing deposit in the CIS (Metal-Pages Ltd., 2008e).

In November, Cronimet announced that the maintenance work at ZCMC, originally planned for early 2009, was to be performed early owing to the current market situation. In 2007, ZCMC processed 10.1 Mt of molybdenum ore to produce 8,160 t of molybdenum in concentrate. Processing capacity for 2008 was expected to increase to 12 million metric tons per year (Metal-Pages Ltd., 2008i).

Production of FeMo in Armenia during January through August was 3,530 t, a decrease of 13.3% compared with the same period in 2007, according to the National Statistical Service of Armenia. However, production of molybdenum concentrate during the period increased by 7.2% to 5,845 t (Metal-Pages Ltd., 2008a).



**Australia.**—In June, Moly Mines Ltd. announced the signing of a 10-year offtake agreement with ThyssenKrupp Metallurgie GmbH (TKMet) (Germany) for all molybdenum production from the Spinifex Ridge molybdenum project in the Pilbara region of Western Australia. Under the terms of the agreement, molybdenum concentrates produced at Spinifex Ridge would be shipped to the Molibdenos y Metales S.A. (Molymet) plant in Santiago, Chile, for conversion to MoX or FeMo (Metals Place, 2008c).

In October, Moly Mines announced that permitting required to commence construction and mining at Spinifex Ridge had been completed. However, the 15-month construction schedule was only to proceed once full project funding had been completed, which full funding was targeted for the first half of 2009, with an initial production date of July 2010. The Spinifex Ridge molybdenum project had proven and probable reserves of 451 Mt and was forecast to produce an average of 10,900 t/yr of molybdenum (Metal-Pages Ltd., 2008h).

**Brazil.**—In June, Carnavale Resources Ltd. of Australia announced the first drilling results of its 100% owned Frei Martinho Molybdenum project in the northeast region of Brazil. The Phase I diamond drilling program was finished in February with 2,046 meters (m) drilled on 18 drill holes. The geologic knowledge acquired during Phase I, in conjunction with regional fieldwork, led the company to acquire additional claims in the region (Carnavale Resources Ltd., 2008).

**Canada.**—Roca Mines Inc. announced molybdenum production of approximately 450 t at its Max Molybdenum Mine near Trout Lake, British Columbia. According to the company, the mine became British Columbia's first new metal mine in a decade and the newest primary molybdenum mine in Canada when it started commercial production in April. The company planned to seek permitting to increase the mine production, in the Phase 2 mine plan. However, as a result of recent global economic uncertainty, the company has undertaken several initiatives to cut costs at the mine, while continuing to operate under its Phase I mine plan. The company was expected to continue to operate the mine at current levels while generating positive cash flow (Roca Mines Inc., 2008).

In January 2009, Adanac Molybdenum Corp. announced that the company would be sold if investors could not be found. The Ruby Creek open pit molybdenum project near Atlin, British Columbia, has 157.7 Mt of proven and probable reserves containing 91,000 t of molybdenum. Adanac targeted initial production of molybdenum in concentrate between 5,400 t/yr and 6,400 t/yr and Adanac initially planned to begin commercial molybdenum production at Ruby Creek by the fourth quarter of 2010. As part of cost cutting measures aimed at saving the company, Adanac laid off nearly 70% of its staff at Ruby Creek, while drastically slowing down construction. Adanac was expected to further reduce operating costs by consolidating its head and engineering offices (Metal-Pages Ltd., 2009a).

**Chile.**—Antofagasta plc announced that molybdenum production at Los Pelambres Mine decreased to 7,800 t in 2008 from 10,200 t in 2007. The company attributed the decrease to lower molybdenum ore grades. However, molybdenum production in the fourth quarter of 2008 was 2,100 t, 10.5% higher than that of the previous quarter. The company expected

molybdenum production in 2009 to be approximately 8,100 t (Antofagasta plc, 2009).

Molymet announced that its Mejillones processing plant in northern Chile was scheduled for completion at the end of 2009. The new plant was expected to have initial processing capacity of approximately 15,000 t/yr to convert molybdenum concentrate into MoX but has been designed to accommodate expansions of up to four times that, if necessary.

In May, Xstrata plc. announced the receipt of environmental approvals from the Antofagasta Region Environmental Authority to construct a molybdenum leaching facility at its Altonorte metallurgical facility. Along with construction of a molybdenum leaching facility, the company was expected to refurbish an idle molybdenum roaster. These two projects have the combined capacity to more than double molybdenum concentrate processing capacity at Altonorte to 28,000 t/yr from 12,000 t/yr for an estimated investment of \$40 million. The company had expected to start construction in the second half of 2008, subject to completion of positive feasibility studies (Xstrata plc., 2008). In October, molybdenum roasting operations at the Altonorte plant were suspended owing to insufficient feedstock and poor market conditions (Xstrata plc., 2009, p. 60).

In August, Corporación Nacional del Cobre de Chile (Codelco) announced plans to invest \$5 billion during 6 years at its Andina Mine in Saladillo to triple copper and molybdenum production. The Andina Mine produced 2,525 t of molybdenum in 2007 (Metal-Pages Ltd., 2008c). In December, despite uncertainty created by the international financial downturn, Codelco announced that it would proceed with the planned investments at its Andina Mine. The first phase of the project was expected to be completed in 2009, with the second phase due to start in 2010 and completed in 2014. However, some analysts thought that Codelco's focus will be on copper, not molybdenum as part of the company's effort to turn around its struggling copper business (Metal-Pages Ltd., 2009b).

**China.**—Jinduicheng Molybdenum Group Co. Ltd. announced that it expected to suspend operation of its 18,000 t/yr molybdenum roaster for the month of August for equipment upgrade (Steel Guru, 2008). Jinduicheng's molybdenum products accounted for roughly 8% of the world market share. China's Ministry of Land and Resources granted Jinduicheng a mining license for 30 years of exploration at the Donggou molybdenum ore deposit in northern China. The deposit, in the western part of Henan Province, was estimated to contain about 650 Mt of crude ore reserves, containing about 690,000 t of molybdenum (Metal-Pages Ltd., 2008g).

In October, a large molybdenum deposit was discovered in southern China's island Province of Hainan. According to the Hainan Provincial Mining Association, the proven molybdenum reserves of the deposit are estimated to be 254,000 t valued at approximately \$14.6 billion. Hainan Jinzhoucheng Molybdenum Co. Ltd., which received the exploration rights for the deposit in 2007, was expected to begin construction in 2009 and begin producing 7,000 t/yr of molybdenum in 2 years (Metals Place, 2008b).

In December, the Chinese Government announced that the export tariff on molybdenum powder and ammonium molybdate

was to be cut to 10% from 15% effective January 1, 2009, while tariffs on other molybdenum-bearing products were to be left unchanged. China's Jinduicheng Molybdenum Co. Ltd., the leading molybdenum producer in Asia, announced that it would greatly benefit from the export tax reduction, especially during the current global economic downturn (Metal-Pages Ltd., 2008b).

**Kazakhstan.**—In February, Russian steelmaker JSC Severstal announced the acquisition of gold and molybdenum miner, Celtic Resources Holdings plc. Severstal paid \$319 million for 100% of Celtic (owner of 50% of the Shorskoye molybdenum mine), which contains 21,000 t of molybdenum (Thomson Reuters, 2008).

**Mexico.**—In April, Creston Moly Corp. (Canada) announced that it would complete a feasibility study on its Creston molybdenum project in Sonora, Mexico, by yearend. The company also announced that it would develop the project alone rather than seeking a partner. The Creston project was a former joint venture by mining companies Amax Mining Corp. and Peñoles Mining Corp., which together completed extensive work on the deposit. Creston acquired the project in the middle of 2007. The Creston project contains a drill-indicated resource of approximately 93 Mt of ore grading 0.083% molybdenum and inferred resources of 84 Mt of molybdenum ore grading 0.076% molybdenum (Metal-Pages Ltd., 2008d).

In December, Creston announced that it would scale back development of the Creston project owing to the economic downturn. It had planned to start production as early as the middle of 2011, but funding was still unsettled (Creston Moly Corp., 2008).

**Mongolia.**—In May, Erdene Gold Inc. (Canada) announced that it expected its Zuun Mod molybdenum deposit in southwestern Mongolia to be one of the largest and most advanced predevelopment projects in the North Asia region. According to the company, the deposit contained measured and indicated resources of 467 Mt at an average grade of 0.044% molybdenum. The company announced that it would continue to advance the project through the feasibility stages in the next coming months (Metal-Pages Ltd., 2008f).

**Peru.**—In January 2009, Sociedad Minera Cerro Verde S.A. announced that it would temporarily suspend the molybdenum circuit at the Cerro Verde Mine in Arequipa. The mine produced 1,360 t of molybdenum in 2008. FCX owns a 54% interest in Cerro Verde (Metal-Pages Ltd., 2009c).

## Outlook

The principal uses for molybdenum were expected to be in chemicals and catalysts and as an additive in steel manufacturing, most importantly alloy and stainless steel. Molybdenum plays a vital role in the energy industry but may become an increasingly essential factor in green technology where it is used in high-strength steels for automobiles to reduce weight and improve fuel economy. Molybdenum may play a critical role in reducing sulfur in liquid fuels by acting as a cracking agent. Production of ultra-low-sulfur diesel fuels now required in the United States were expected to more than double the amount of molybdenum used in oil refineries. Analysts

expected global demand for these types of catalysts to increase by more than 5% annually until 2013.

As worldwide energy demand increases, new oil and gas pipelines are being built at a rapid rate. Pipelines are getting thinner to reduce costs and are operating under higher pressures to increase flow and only steels containing molybdenum can meet the specifications required. For example, the first Chinese west-to-east gas pipeline will transport gas to the energy-hungry Yangtze River Delta in the east from Xinjiang Province in the west of China. The pipeline, due for completion in 2011, was expected to require 4.4 Mt of molybdenum-containing steel. This would equate to approximately 12,000 t of molybdenum (Metal-Pages Ltd., 2009d).

The first three quarters of 2008 were characterized by a steadily increasing world molybdenum market amidst the downturn in the world financial markets. However, in November the downturn also hit the molybdenum market, causing massive molybdenum production cuts as well as the postponement of many new molybdenum projects. Many analysts thought that by the fourth quarter of 2009 and first quarter of 2010, molybdenum production will begin to slowly increase, allowing many of the new molybdenum projects to resume construction.

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TABLE 1  
SALIENT MOLYBDENUM STATISTICS<sup>1</sup>

(Metric tons of contained molybdenum)

	2004	2005	2006	2007	2008
United States:					
Concentrate:					
Production	41,500	58,000	59,800	57,000	55,900
Shipments	42,000	57,900	60,100	57,100 <sup>r</sup>	57,800
Reported consumption <sup>2</sup>	38,700	46,600	44,400	43,900	44,000
Imports for consumption	8,780	11,900	10,900	12,400	10,200
Stocks, December 31:					
Concentrate, mine and plant	2,610	3,620	2,120	2,630	1,760
Product producers <sup>3</sup>	2,840	3,770	3,210	3,140	3,850
Consumers	2,030	2,030	1,660	1,870 <sup>r</sup>	1,620
Total	7,480 <sup>r</sup>	9,420	6,990	7,640 <sup>r</sup>	7,230
Primary products:					
Production	66,300	78,500	78,000	72,800	72,800
Shipments	39,300	46,700	51,000	48,700	51,200
Reported consumption	17,400	18,900	19,000	21,000 <sup>r</sup>	20,900
World, mine production	159,000	186,000	186,000 <sup>r</sup>	213,000 <sup>r</sup>	218,000 <sup>e</sup>

<sup>r</sup>Estimated. <sup>r</sup>Revised.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Molybdenum concentrates roasted to make molybdenum oxide.

<sup>3</sup>Includes 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  
PRODUCTION, SHIPMENTS, AND STOCKS OF MOLYBDENUM PRODUCTS IN THE UNITED STATES<sup>1</sup>

(Metric tons of contained Mo)

	Metal powder		Other <sup>2</sup>		Total	
	2007	2008	2007	2008	2007	2008
Received from other producers	--	3	17,600	19,000	17,600	19,000
Gross production during year	5,090	5,040	67,700	67,800	72,800	72,800
Molybdenum products used to make other products	3,470	3,400	38,200 <sup>r</sup>	36,000	41,700	39,400
Net production	1,620	1,640	29,500	31,800	31,100	33,400
Shipments	1,650	1,650	47,100	49,500	48,700	51,200
Producer stocks, December 31	275	285	2,870	3,560	3,140	3,850

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes ammonium, calcium, and sodium molybdate; ferromolybdenum; molybdenum disulfide; molybdenum hexacarbonyl; molybdenum metal; molybdenum pentachloride; molybdic acid; molybdic oxides; pellets; and phosphomolybdic acid.



TABLE 3  
U.S. REPORTED CONSUMPTION, BY END USES, AND CONSUMER STOCKS OF MOLYBDENUM MATERIALS<sup>1</sup>

(Kilograms of contained Mo)

End use	Molybdic oxides	Ferromolybdenum <sup>2</sup>	Ammonium and sodium molybdate	Molybdenum scrap	Other	Total
2007:						
Steel:						
Carbon	567,000	W	--	--	W	567,000 <sup>r</sup>
High-strength low-alloy <sup>r</sup>	745,000	146,000	--	--	136,000	1,030,000
Stainless and heat-resisting	2,070,000	774,000	--	W	123,000 <sup>r</sup>	2,970,000 <sup>r</sup>
Full alloy	3,080,000	3,390,000	--	--	18,100	6,500,000 <sup>r</sup>
Tool	W	W	--	W	--	W
Total	6,470,000 <sup>r</sup>	4,310,000 <sup>r</sup>	--	W	278,000 <sup>r</sup>	11,100,000 <sup>r</sup>
Cast irons (gray, malleable, ductile iron)	W	345,000	--	--	51,500	396,000
Superalloys	900,000	W	--	W	1,450,000 <sup>r</sup>	2,350,000 <sup>r</sup>
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	W	--	--	728	728 <sup>r</sup>
Other alloys	W	51,500	--	904	909	53,400
Mill products made from metal powder <sup>3</sup>	W	--	--	--	2,400,000	2,400,000
Cemented carbides and related products <sup>4</sup>	--	--	--	--	W	W
Chemical and ceramic uses:						
Pigments	W	--	W	--	--	W
Catalysts	948,000	--	W	--	W	948,000
Other	--	--	--	--	7,200	7,200
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	283,000	283,000
Other <sup>r</sup>	904,000	526,000	988,000	813,000	259,000	3,490,000
Grand total	9,220,000 <sup>r</sup>	5,230,000	988,000	814,000	4,730,000 <sup>r</sup>	21,000,000 <sup>r</sup>
Stocks, December 31	600,000 <sup>r</sup>	331,000 <sup>r</sup>	17,200	28,400	895,000 <sup>r</sup>	1,870,000 <sup>r</sup>
2008:						
Steel:						
Carbon	547,000	W	--	--	W	547,000
High-strength low-alloy	806,000	150,000	--	--	136,000	1,090,000
Stainless and heat-resisting	2,200,000	799,000	--	W	114,000	3,110,000
Full alloy	3,290,000	3,640,000	--	--	18,100	6,950,000
Tool	W	W	--	W	--	W
Total	6,840,000	4,590,000	--	W	268,000	11,700,000
Cast irons (gray, malleable, ductile iron)	W	377,000	--	--	51,500	429,000
Superalloys	820,000	W	--	W	1,130,000	1,950,000
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	W	--	--	728	728
Other alloys	W	84,600	--	--	4,530	89,200
Mill products made from metal powder <sup>3</sup>	40,000	--	--	--	2,230,000	2,270,000
Cemented carbides and related products <sup>4</sup>	--	--	--	--	W	W
Chemical and ceramic uses:						
Pigments	W	--	W	--	--	W
Catalysts	945,000	--	W	--	W	945,000
Other	--	--	--	--	6,930	6,930
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	279,000	279,000
Other	674,000	508,000	958,000	878,000	226,000	3,240,000
Grand total	9,320,000	5,560,000	958,000	878,000	4,200,000	20,900,000
Stocks, December 31	338,000	332,000	14,300	35,300	898,000	1,620,000

<sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data; included with "Other" of the "Miscellaneous and unspecified uses" category. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes calcium molybdate.

<sup>3</sup>Includes ingot, wire, rod, and sheet.

<sup>4</sup>Includes construction, mining, oil and gas, and metal working machinery.

TABLE 4  
U.S. EXPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY<sup>1</sup>

Product and country	HTS <sup>2</sup> code	2007		2008	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Oxides and hydroxides, gross weight:	2825.70.0000				
Austria		1,410	\$39,600	1,610	\$46,600
Belgium		1,730	27,900	788	31,900
Canada		3,290	39,100	4,800	59,700
Chile		1,480	52,500	--	--
Finland		1,310	41,200	514	15,700
Germany		535	16,400	220	6,100
Japan		2,100	68,500	4,320	122,000
Korea, Republic of		467	18,000	429	13,800
Netherlands		229	7,910	1,230	45,100
Slovenia		487	15,600	568	14,900
United Kingdom		713	26,600	760	28,200
Other		1,110 <sup>r</sup>	25,000 <sup>r</sup>	1,420	44,400
Total		14,900	378,000	16,700	428,000
Molybdates, all, gross weight:	2841.70.0000				
Belgium		1	77	221	2870
Canada		470	8,170	393	7,500
Japan		372	9,330	250	10,300
Netherlands		320	15,300	317	16,900
Other		274 <sup>r</sup>	9,700 <sup>r</sup>	361	9,160
Total		1,440	42,500	1,540	46,700
Ferromolybdenum, contained weight: <sup>3</sup>	7202.70.0000				
Canada		838	44,700	933	42,900
Mexico		24	1,390	59	3,760
Netherlands		145	8,550	280	14,600
Other		215	13,200	17	1,150
Total		1,220	67,900	1,290	62,400
Molybdenum, other, gross weight: <sup>4</sup>	Various <sup>5</sup>				
Brazil		94	7,980	77	7,440
Canada		102	4,890	149	7,270
Germany		136	10,900	171	12,300
Hungary		66	5,590	42	4,480
Israel		53	4,140	118	9,250
Japan		476	44,500	623	69,200
Kenya		--	--	58	800
Korea, Republic of		228	20,200	165	21,900
Mexico		14	1,480	79	4,910
South Africa		2	51	77	3,660
Taiwan		197	8,880	94	8,860
United Kingdom		360	18,600	273	16,900
Other		410 <sup>r</sup>	29,400 <sup>r</sup>	263	24,700
Total		2,140	156,000	2,190	192,000

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States.

<sup>3</sup>Ferromolybdenum contains about 60% to 65% molybdenum.

<sup>4</sup>Includes powder, unwrought, waste and scrap, wire, wrought, and other.

<sup>5</sup>Includes 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 OTHER CONCENTRATES), BY COUNTRY<sup>1</sup>

Country	2007		2008	
	Quantity (metric tons of contained Mo)	Value (thousands)	Quantity (metric tons of contained Mo)	Value (thousands)
Argentina	--	--	210	\$11,200
Belgium	6,730	\$360,000	6,910	479,000
Canada	2,580	109,000	2,030	92,400
Chile	1,270	64,600	316	19,600
China	71	2,900	365	6,630
India	119	7,280	33	1,440
Japan	2,230	122,000	2,220	132,000
Korea, Republic of	232	11,900	694	36,900
Latvia	20	350	20	350
Mexico	4,760	41,700	4,470	60,400
Netherlands	9,660	566,000	9,960	615,000
United Kingdom	5,800	339,000	5,080	352,000
Vietnam	5	174	341	5,770
Other	344 <sup>r</sup>	12,200 <sup>r</sup>	66	2,340
Total	33,800	1,640,000	32,700	1,810,000

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 6  
U.S. EXPORTS OF MOLYBDENUM PRODUCTS<sup>1</sup>

Item	HTS <sup>2</sup> code	2007			2008		
		Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	NA	17,100	\$906,000	NA	17,800	\$1,140,000
Molybdenum ore and concentrates, other	2613.90.0000	NA	16,700	731,000	NA	14,900	677,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	14,900	NA	378,000	16,700	NA	428,000
Molybdates, all	2841.70.0000	1,440	NA	42,500	1,540	NA	46,700
Ferromolybdenum	7202.70.0000	1,760	1,220	67,900	1,840	1,290	62,400
Molybdenum powders	8102.10.0000	616	NA	35,900	543	NA	34,800
Molybdenum unwrought, bars and rods	8102.94.0000	86	NA	5,660	45	NA	2,910
Molybdenum waste and scrap	8102.97.0000	478	NA	18,200	280	NA	7,360
Molybdenum wire	8102.96.0000	253	NA	23,900	235	NA	23,500
Molybdenum, other	Various <sup>3</sup>	707	NA	72,900	1080	NA	123,000
Total		20,200	35,000	2,280,000	22,200	34,000	2,540,000

NA Not available.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States.

<sup>3</sup>Includes HTS codes 8102.95.0000 and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 7  
U.S. IMPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY<sup>1</sup>

Product and country	HTS <sup>2</sup> code	2007		2008	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Oxides and hydroxides, gross weight:	2825.70.0000				
Chile		176	\$7,610	143	\$6,110
Czech Republic		--	--	21	637
Mongolia		--	--	126	5,140
Switzerland		5	51	31	921
Other		30 <sup>r</sup>	352 <sup>r</sup>	13	123
Total		211	8,020	335	12,900
Molybdates, all, contained weight:	Various <sup>3</sup>				
Belgium		16	414	11	405
Canada		7	315	4	172
Chile		145	9,750	110	8,310
China		185	7,190	80	4,270
Germany		204	14,500	22	1,740
Japan		8	320	7	357
Other		1 <sup>r</sup>	32 <sup>r</sup>	(4)	24
Total		567	32,500	235	15,300
Molybdenum orange, gross weight:	3206.20.0020				
Canada		519	3,660	324	2,840
Colombia		--	--	12	29
Mexico		57	281	31	203
Other		24 <sup>r</sup>	99 <sup>r</sup>	6	40
Total		600	4,040	373	3,110
Ferromolybdenum, contained weight: <sup>5</sup>	7202.70.0000				
Brazil		14	846	11	722
Canada		491	32,800	267	19,400
Chile		1,380	92,600	1,650	119,000
China		1,910	130,000	318	22,100
Korea, Republic of		72	4,640	24	1,520
Netherlands		26	1,890	12	923
Sweden		--	--	20	1,570
Other		209 <sup>r</sup>	6,340 <sup>r</sup>	16	891
Total		4,100	270,000	2,320	166,000
Other, gross weight:	Various <sup>6</sup>				
Austria		401	32,800	370	32,200
China		277	19,300	645	47,400
Germany		129	8,980	165	8,600
Hong Kong		2	123	17	1,120
Japan		46	3,160	84	7,940
Mexico		17	113	61	229
Russia		32	4,670	27	4,500
Taiwan		3	68	22	1,480
Other		39 <sup>r</sup>	1,670 <sup>r</sup>	31	2,040
Total		946 <sup>r</sup>	70,900	1,420	105,000

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States.

<sup>3</sup>Includes HTS codes 2841.70.1000 and 2841.70.5000.

<sup>4</sup>Less than ½ unit.

<sup>5</sup>Ferromolybdenum contains about 60% to 65% molybdenum.

<sup>6</sup>Includes 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 OTHER CONCENTRATES), BY COUNTRY<sup>1</sup>

Country	2007		2008	
	Quantity (metric tons of contained Mo)	Value (thousands)	Quantity (metric tons of contained Mo)	Value (thousands)
Armenia	55	\$3,640	124	\$7,470
Canada	1,520	97,200	2,440	155,000
Chile	5,740	333,000	2,380	170,000
Mexico	3,910	78,700	3,180	58,200
Peru	1,130	38,800	2,090	120,000
Other	31 <sup>r</sup>	1,710 <sup>r</sup>	17	1,020
Total	12,400	553,000	10,200	512,000

<sup>r</sup>Revised.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 9  
U.S. IMPORTS FOR CONSUMPTION OF MOLYBDENUM PRODUCTS<sup>1</sup>

Item	HTS <sup>2</sup> code	2007			2008		
		Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	8,680	5,430	\$181,000	9,950	6,060	\$249,000
Molybdenum ore and concentrates, other	2613.90.0000	15,000	6,960	372,000	9,140	4,170	263,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	211	NA	8,020	335	NA	12,900
Molybdates, all	Various <sup>3</sup>	1,090	567	32,500	452	235	15,300
Molybdenum orange	3206.20.0020	600	NA	4,040	373	NA	3,110
Ferromolybdenum	7202.70.0000	6,360	4,100	270,000	2,470	2,320	166,000
Molybdenum powders	8102.10.0000	73	61	4,990	76	64	7,070
Molybdenum unwrought, bars and rods	8102.94.0000	117	117	7,460	256	255	15,800
Molybdenum waste and scrap	8102.97.0000	574	554	34,800	588	546	30,900
Molybdenum wire	8102.96.0000	18	NA	2,740	20	NA	3,060
Molybdenum, other	Various <sup>4</sup>	164	NA	20,900	483	NA	48,700
Total		32,900	17,800	938,000	24,100	13,700	814,000

NA Not available.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States.

<sup>3</sup>Includes HTS codes 2841.70.1000 and 2841.70.5000.

<sup>4</sup>Includes HTS codes 8102.95.3000, 8102.95.6000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 10  
MOLYBDENUM-PRODUCING MINES IN THE UNITED STATES IN 2008

State and mine	County	Operator	Source of molybdenum
Arizona:			
Bagdad	Yavapai	Freeport McMoRan Copper & Gold Inc.	Copper-molybdenum ore, concentrated.
Mineral Park	Mohave	Mercator Minerals, Ltd.	Do.
Mission Complex	Pima	Asarco LLC	Do.
Morenci	Greenlee	Freeport McMoRan Copper & Gold Inc.	Do.
Sierrita	Pima	do.	Do.
Colorado, Henderson	Clear Creek	do.	Molybdenum ore, concentrated.
Idaho, Thompson Creek	Custer	Thompson Creek Metals Co.	Do.
Montana, Continental Pit	Silver Bow	Montana Resources	Copper-molybdenum ore, concentrated.
Nevada, Ashdown	Humboldt	Golden Phoenix Minerals, Inc.	Molybdenum ore, concentrated.
New Mexico:			
Chino	Grant	Freeport McMoRan Copper & Gold Inc.	Copper-molybdenum ore, concentrated.
Questa	Taos	Molycorp, Inc.	Molybdenum ore, concentrated.
Utah, Bingham Canyon	Salt Lake	Kennecott Utah Copper Corp.	Copper-molybdenum ore, concentrated.
Do., do. Ditto.			

TABLE 11  
MOLYBDENUM: WORLD MINE PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons of contained molybdenum)

Country <sup>3</sup>	2004	2005	2006	2007	2008 <sup>e</sup>
Armenia	2,950 <sup>e</sup>	3,000 <sup>e</sup>	3,900	4,080	4,250 <sup>p</sup>
Canada	9,519	7,667 <sup>r</sup>	7,117 <sup>r</sup>	6,819 <sup>r</sup>	7,724 <sup>4</sup>
Chile	41,883	48,041	43,278	44,912	33,687 <sup>4</sup>
China <sup>e</sup>	38,500	40,000	43,900	66,700 <sup>r</sup>	81,000
Iran <sup>e</sup>	1,800	2,476 <sup>4</sup>	2,500 <sup>4</sup>	3,600 <sup>r</sup>	3,800
Kazakhstan	230 <sup>e</sup>	230	250	400	400
Kyrgyzstan <sup>e</sup>	250	250	250	250	250
Mexico	3,730	4,246	2,519	6,159	7,812 <sup>4</sup>
Mongolia	1,141	1,188	1,404	1,978 <sup>r</sup>	2,000
Peru	14,246	17,325	17,209	16,737	16,721 <sup>4</sup>
Russia <sup>e</sup>	2,900	3,000	3,100	3,300	3,600
United States	41,500	58,000	59,800	57,000	55,900 <sup>4</sup>
Uzbekistan <sup>e</sup>	500	575	600	600	500
Total	159,000	186,000	186,000 <sup>r</sup>	213,000 <sup>r</sup>	218,000

<sup>e</sup>Estimated. <sup>p</sup>Preliminary. <sup>r</sup>Revised.

<sup>1</sup>World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Table includes data available through June 15, 2009.

<sup>3</sup>In addition to the countries listed, North Korea, Romania, and Turkey are thought to produce molybdenum, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

<sup>4</sup>Reported figure.