



# 2010 Minerals Yearbook

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## MOLYBDENUM

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In the United States, mine production of molybdenum concentrate in 2010 increased by 24% to 59,400 metric tons (t) from the 47,800 t of 2009 (table 1). Estimated world mine production of molybdenum in 2010 was about 242,000 t, a 9% increase from 221,000 t in 2009. The U.S. share of world production was 25% in 2010. Reported U.S. consumption of molybdenum concentrate for roasting in 2010 increased by 26% compared with that of 2009.

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 molybdic 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. There is significant use of molybdenum 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 in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah. Other molybdenum sources do not contribute significantly 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 10 U.S. operations that currently 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, 2010, U.S. rated capacity for mines and mills was estimated to be about 73,800 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, which could be brought into production within a short period of time with minimal capital expenditure.

Primary molybdenum production continued at the Ashdown Mine in Nevada, the Henderson Mine in Colorado, the Questa Mine in New Mexico, and the Thompson Creek Mine in Idaho. The Ashdown Mine, in Humboldt County, produced 96 t of molybdenum in 2010. The company announced that it had developed access to additional reserves, and in 2011 was expected to raise production rates to 2008 levels of roughly 46 t of molybdenum per quarter (CNW Group, 2011).

Freeport-McMoRan Copper & Gold Inc. (FCX) announced that its Henderson Mine produced 18,140 t of molybdenum in 2010, a 48% increase compared with 12,250 t produced in 2009. Henderson also produced 18,140 t of molybdenum in 2008. The Henderson underground mine produces high-purity, chemical-grade molybdenum concentrates, which typically are further processed into value-added molybdenum chemical products (Freeport-McMoRan Copper & Gold Inc., 2011a, p. 22, 106). The Henderson operation consists of a large underground mining complex feeding a concentrator with the capacity to produce approximately 18,200 t/yr of molybdenum (Freeport-McMoRan Copper & Gold Inc., 2011b, p. 13).

FCX announced that total consolidated molybdenum sales from Henderson Mine and byproduct production at its North American and South American copper mines totaled 30,390 t of molybdenum in 2010, a 16% increase compared with sales of 26,300 t of molybdenum in 2009. FCX attributed this increase to improved demand in the chemicals sector (Freeport-McMoRan Copper & Gold Inc., 2011a, p. 22, 25).

FCX announced that construction activities at its idle Climax molybdenum mine were expected to continue into 2011. In 2010, concrete foundations for various equipment installations were completed, and the ball mill shell assembly commenced. The company announced that startup of mining and milling activities would be dependent on market conditions. The Climax Mine had an initial design capacity of 13,600 t/yr of molybdenum, with significant expansion options. The estimated remaining costs for the project were approximately \$450 million (Freeport-McMoRan Copper & Gold Inc., 2011c).

Thompson Creek Metals Company Inc. (TCMC) owns the Thompson Creek open pit molybdenum mine and mill near Challis, ID, 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. The molybdenum concentrate produced at the Thompson Creek Mine is transported to the Langeloth facility, which produces ferromolybdenum products, molybdenum trioxide, and other specialty products. The Langeloth facility also processes

nonmolybdenum catalysts for various customers, primarily in the food industry. TCMC had two high-grade underground molybdenum deposits, the Davidson deposit near Smithers, British Columbia, Canada, and the Mount Emmons deposit near Crested Butte, CO (Thompson Creek Metals Company Inc., 2011, p. 42).

TCMC announced that its Thompson Creek Mine produced 11,370 t of molybdenum in 2010, a 41% increase from the 8,080 t of molybdenum produced in 2009. The increase was primarily because of significantly higher grade of ore from the Thompson Creek Mine. The company expected the Thompson Creek Mine to have higher production for the first half of 2011 (6,350 to 6,800 t of molybdenum) than the last half of 2011 (3,630 to 4,080 t of molybdenum) mainly owing to the tapering off of higher grade production (Thompson Creek Metals Company Inc., 2011, p. 65–66).

Molybdenum was produced as a byproduct of copper production at the Bagdad, Mineral Park, and Sierrita Mines in Arizona; the Continental Pit Mine in Montana; the Robinson Mine in Nevada; and the Bingham Canyon Mine in Utah (table 10). The Morenci and Mission Mines in Arizona as well as the Chino Mine in New Mexico did not produce molybdenum in 2010. In the case of byproduct molybdenum recovery at a copper mine, all mining costs associated with producing molybdenum concentrate are allocated to the primary metal (copper). In 2010, byproduct molybdenite recovery accounted for approximately 50% of the U.S. molybdenum supply.

The Bagdad operation of FCX includes a 75,000 metric-ton-per-day (t/d) concentrator that produces copper and molybdenum concentrates, as well as a pressure leach plant that processes molybdenum concentrate. Molybdenum production at Bagdad in 2010 was 3,180 t, a 17% increase compared with 2,720 t of molybdenum in 2009 (Freeport-McMoRan Copper & Gold Inc., 2011b, p. 8).

The Sierrita operation of FCX includes a 102,000-t/d concentrator that produces copper and molybdenum concentrates. It also has molybdenum facilities consisting of a leaching circuit, two molybdenum roasters, and a packaging facility. The molybdenum facilities process concentrate from Sierrita, concentrate from other FCX mines, and concentrate from third-party sources. Molybdenum production at Sierrita in 2010 was 8,160 t of molybdenum, a 15% decrease compared with 9,620 t of molybdenum in 2009 (Freeport-McMoRan Copper & Gold Inc., 2011b, p. 9).

Rio Tinto plc (London, United Kingdom) announced that molybdenum concentrate production at its Bingham Canyon Mine (operated by Kennecott Utah Copper) was 12,900 t of molybdenum compared with 11,300 t of molybdenum in 2009 (Rio Tinto plc, 2011, p. 84). In April, Rio Tinto announced that its Kennecott Utah Copper operation launched construction of a \$340 million molybdenum autoclave process facility that was expected to improve process efficiency and metal recovery, and to reduce greenhouse gas emission intensity. First production from phase I was anticipated in the fourth quarter of 2012, and full capacity of 13,600 t/yr of molybdenum was scheduled for the fourth quarter of 2013. The phase 2 expansion to 27,200 t/yr of molybdenum was anticipated to be completed in the first quarter of 2015. Kennecott also submitted permits to move

forward with the Cornerstone project, which was expected to extend the life of its Bingham Canyon Mine and operations to 2028 (Rio Tinto plc, 2011, p. 47–48).

In March, General Moly Inc. announced that Hanlong (USA) Mining Investment Inc., a wholly owned subsidiary of Sichuan Hanlong Group (Hanlong), agreed to procure \$745 million in debt and equity, which would fully fund the Mt. Hope project in central Nevada. General Moly has an 80% stake in the Mount Hope project, with reserves of 590,000 t of molybdenum and a mine life in excess of 40 years. The remaining 20% is owned by Pohang Iron and Steel Co. (POSCO), a firm based in Pohang, South Korea. Permitting, which began in 2006, was ongoing, and the company expected all work to be completed near the end of 2011 or early 2012. Initial production was expected approximately 20 months after construction has begun (General Moly Inc., 2011, p. 4–6).

In February 2011, Northern Dynasty Minerals Ltd. (Vancouver, British Columbia, Canada) announced the completion of a preliminary assessment of its Pebble copper-gold-molybdenum project in southwestern Alaska. The assessment confirmed that if just 32% of the site was developed, the project had the potential to produce approximately 14 Mt of copper and 635,000 t of molybdenum during a 45-year period. The preliminary assessment updated and substantially revised the project economic analysis last done by the company in 2004. A prefeasibility study was expected to be completed in 2012, prior to the completion of the permitting process under the National Environmental Policy Act (Northern Dynasty Minerals Ltd., 2011, p. 3).

## Consumption

In 2010, U.S. reported consumption of molybdenum contained in concentrate for roasting was approximately 26% more than that of 2009 (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 2010 was 7% more than that of 2009. MoX was the leading form of molybdenum used by industry, particularly in making stainless steel. Overall, total Mo use in steel in 2010 increased by 16% from that of 2009, and use in superalloys in 2010 increased by 18% from that of 2009 (table 3).

Metallurgical applications dominated molybdenum use in 2010, accounting for about 88% of 2010 grand total reported consumption (table 3). In 2010, FeMo accounted for 36% 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 is playing a more important role in green technology than ever before, with use focused on biofuels, catalysts, ethanol, solar panels, and wind power. In May, a team of researchers with the U.S. Department of Energy's Lawrence Berkeley National Laboratory and the University of California, Berkeley, announced the discovery of an inexpensive new proton reduction catalyst, seventy times less expensive than platinum commonly used now to produce hydrogen gas. The new catalyst was based on a molybdenum-oxo metal complex

that generates hydrogen from water without the use of additional acids or organic solvents. These qualities were expected to make the catalyst ideal for renewable energy use (Karunadasa and others, 2010).

A new type of solar panel made of copper-indium-gallium-selenide (CIGS) cells contains 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 small, CIGS technology has demonstrated the highest conversion efficiency and the longest product life within the solar power-production industry. Analysts estimate that CIGS cells use approximately 1,100 t of molybdenum per gigawatt of capacity (Compound Semiconductor, 2010).

## Stocks

At yearend 2010, producer plus consumer industry stocks increased compared with yearend 2009 stocks. Inventories of molybdenum in concentrate at mines and plants decreased by about 360 t. Producer stocks of molybdenum in FeMo, molybdates, MoX, metal powders, and other products increased compared with producer stocks of 2009 (table 2).

## Prices

Prices were reported in Platts Metals Week in dollars per pound of contained molybdenum. In January 2010, the average prices for MoX and FeMo were \$14.50 per pound and \$17.00 per pound, respectively. Prices slowly increased reaching a 2010 high of \$17.58 per pound MoX and \$21.69 per pound FeMo average for the month of April. Prices slightly fluctuated for the remainder of the year with an average price of \$16.19 per pound MoX and \$18.47 per pound FeMo for the month of December.

## Foreign Trade

In 2010, molybdenum-containing material exports collectively contained about 11,700 t (gross weight) and were valued at \$1.37 million (table 6). Imports for consumption of molybdenum-containing products collectively contained about 33,500 t (gross weight) and were valued at \$576 million (table 9).

## World Review

World molybdenum reserves and production capacity were concentrated in a few countries. World mine output in 2010 was estimated to have been 242,000 t (molybdenum contained in concentrate), of which, in descending order of production, China, the United States, Chile, Peru, Mexico, and Canada provided about 94% (table 11). Peru increased molybdenum production by about 40% from 2009 to 2010.

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 largest in the world 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.

According to a study performed by the International Molybdenum Association and by the Steel & Metals Market Research Company, in 2009, global Mo consumption in all applications was 212,000 t, which included new and recycled molybdenum. Most recycled Mo is introduced as scrap in steelmaking. Their analysis was based on more than 250 interviews with key Mo end users. For all applications, according to their study, approximately 15% of Mo input material originated from scrap. Molybdenum was used in the following end uses—engineering steels (34%), stainless steels (26%), chemical products (13%), tool and high-speed steels (10%), cast iron (7%), superalloys (5%), and Mo metal (5%) (International Molybdenum Association, 2011, p. 2).

**Armenia.**—Production and sales of molybdenum concentrate at the Karajan copper-molybdenum mine, managed by Zangezur Copper and Molybdenum Combine CJSC (ZCMC), a subsidiary of Cronimet Mining GmbH (Germany), increased by 2.3% to 8,800 t of molybdenum in 2010. The Karajan copper-molybdenum mine is in the southeastern corner of Armenia in the Province of Syunik. ZCMC was in the final stages of completing a multimillion dollar ore processing facility, which was expected to be one of the largest mills, by production capacity, in the CIS countries. According to the company, its main strategy was to have processing infrastructure for copper and molybdenum which meet Western standards (Mining Journal, 2011, p. 7).

Agarak Copper and Molybdenum Combine (ACMC), located in the southern Armenian Province of Syunik, was acquired by GeoProMining Ltd. (GPM) in 2007. According to the company, ACMC produced 254 t of molybdenum concentrates in the first 6 months of 2010. GPM announced that it planned to install new flotation machines and upgrade new equipment to increase its molybdenum recovery rate. The upgrades were anticipated to be completed in early 2012 (Mining Journal, 2011, p. 11).

**Australia.**—Moly Mines Ltd. (Perth, Australia) announced that mining activities were expected to start in August 2010 at its Spinifex Ridge molybdenum project in the Pilbara region of Western Australia. In April, Hanlong Mining Investment Pty. Ltd. became Moly Mines' controlling shareholder (55%), following the settlement of a \$200 million equity and debt funding package (Moly Mines Ltd., 2010, p. 1). According to the company, site construction work had commenced and work on the Utah Point export facility was on schedule. The facility was expected to receive Spinifex Ridge ore at the end of October (Engineering and Mining Journal, 2010).

Moly Mines had initially planned to develop and operate a mining operation at Spinifex Ridge that would produce 20 million metric tons per year (Mt/yr) of molybdenum ore, based on a 24-year mine life. However, a dramatic fall in molybdenum

prices in late 2008 led the company to revise its plans for a smaller 10-Mt/yr ore operation, with a possibility of future expansion (Engineering and Mining Journal, 2010).

In April, Ivanhoe Mines Ltd. announced it would start a prefeasibility study for its high-grade Merlin molybdenum and rhenium deposit, which comprises the Mt. Dore project in the Cloncurry District in northwestern Queensland, part of Ivanhoe Australia Ltd. (Vancouver, British Columbia, Canada). Environmental permitting was expected to be carried out in parallel with the prefeasibility study. Indicated resources total 6.5 Mt at a grade of 1.3% molybdenum and 23 grams per ton rhenium. Production was expected to produce approximately 5,300 t/yr of molybdenum and 7.5 t/yr of rhenium, with an initial mine life of 9 years. Production was expected to begin in the third quarter of 2012. Despite its high molybdenite content, the silicate nature of the Merlin ore might make it difficult to convert to salable high-grade molybdenum concentrate. Therefore, the scoping study, released in March, suggested the best value would be achieved by producing a rough grade concentrate and leaching and roasting this concentrate to produce molybdenum oxide and ammonium perhenate (Ivanhoe Mines Ltd., 2011, p. 9, 13).

**Canada.**—Roca Mines Inc. announced molybdenum production of approximately 630 t of molybdenum concentrate at its Max molybdenum mine from August 2009 to August 2010, a 42% decrease compared with the 1,080 t during the same period of the previous year. The Max underground molybdenum mine is near Trout Lake, British Columbia. Roca Mines sells the molybdenum concentrates produced at its Max Mine to a British-based buyer (Roca Mines Inc., 2010).

TCMC announced in August 2009 that the Endako Mine expansion project that was postponed in December 2008, owing to the economic downturn, was approved to resume. In July 2010, TCMC received the approval of TCMC's joint-venture partner, Sojitz Corp., for the mill expansion project. The expansion project included an upgrade of all processing equipment, construction of a new modern mill building, and a new mining plan, which was expected to widen the area being mined. As a result of the mill expansion, annual molybdenum production was expected to be between 6,800 and 7,300 t/yr of molybdenum, of which TCMC 75% share would be between 5,000 and 5,400 t/yr of molybdenum. The mill expansion project was expected to be completed in the fourth quarter of 2011, with additional production ramping up from the Endako Mine during that quarter. The Endako Mine is near Fraser Lake, 161 kilometers (km) northwest of Prince George, British Columbia. The Endako Mine is a fully integrated facility that includes a concentrator and a roasting facility. Production from the Endako Mine is sold primarily under annual supply contracts to customers from the chemical, petroleum catalyst, and chemical fields (Thompson Creek Metals Company, 2011, p. 8, 24, 34–35).

Taseko Mines Ltd. announced that it produced 430 t of molybdenum in 2010, a 50% increase compared with 285 t of molybdenum produced in 2009 at its Gibraltar Mine in south-central British Columbia. According to the company, the production increase was a direct result of the investments in

mine and concentrator equipment performed in 2010 (Taseko Mines Ltd., 2011).

**Chile.**—Corporación Nacional del Cobre de Chile (Codelco), the state-controlled copper and molybdenum producer, announce a 60% increase in net earnings to \$1.87 billion in 2010 owing to higher copper and molybdenum prices. Molybdenum production rose to 22,000 t in 2010, a slight increase compared with the 21,500 t produced in 2009. According to the company, its molybdenum production was expected to increase during the next 3 to 5 years, as new ore zones containing more molybdenum were brought into production at its Andina, Chuquicamata, and El Teniente Mines in Chile (Metal-Pages, 2011c).

Antofagasta plc announced that molybdenum production at its Los Pelambres Mine was 8,800 t of molybdenum, a 13% increase compared with 7,800 t of molybdenum produced in 2009. Los Pelambres is in Chile's Coquimbo Region, 240 km northeast of Santiago. According to the company, the plant expansion initiated in mid-2008 was successfully completed, on schedule and on budget, during the first quarter of 2010. The company expected to produce approximately 9,300 t of molybdenum in 2011, based on the plant expansion and a stable molybdenum grade of approximately 0.019% Mo (Antofagasta plc, undated, p. 17, 28).

Molibdenos y Metales S.A. (Molymet) announced that construction of the Molynor Industrial Complex, in the port of Mejillones in northern Chile began in 2008 and was fully operational in January 2010. According to the company, the new plant was expected to have a production capacity of 13,600 t/yr of molybdenum (Molibdenos y Metales S.A., 2011).

**China.**—China's imports of molybdenum concentrates decreased by 58% in the first 11 months of 2010 compared with imports during the same period of 2009, according to official customs data. China imported 5,464 t of Mo concentrate in the January through November 2010 period, with an average price of \$10,909 per metric ton, 15% higher than the average price during the same period in 2009 (Metal-Pages, 2011a). China's exports of MoO<sub>3</sub> (roasted molybdenum concentrate) increased 157% in the first 11 months of 2010, compared with exports during the same period of 2009. China exported 20,413 t of MoO<sub>3</sub>, with an average price of \$20,202 per metric ton, 37% higher than the average price during the same period in 2009 (Metal-Pages, 2011b).

China's Ministry of Land and Natural Resources announced that molybdenum would be the sixth protected mined mineral added to a list of strategic resources starting in January 2011. Molybdenum will join antimony, gold, rare earths, tin, and tungsten on its list. China was expected to begin restricting the mining and export of molybdenum as of January 2011 (Metal-Pages, 2010a). In December, China's Ministry of Commerce released the first batch of export quotas for molybdenum chemicals (2,400 t), molybdenum fabricated products (2,295 t), and molybdenum primary materials (20,312 t) for 2011. Molybdenum chemicals included ammonium molybdate, other molybdate salts, and molybdenum oxides and hydrates. Molybdenum fabricated products included molybdenum powder, unwrought metal, and scrap. Molybdenum primary materials included roasted and unroasted molybdenum concentrates and ferromolybdenum. The first

batch of export quotas were unchanged from the first batch of export quotas released in 2009 (Metal-Pages, 2010b).

**Mongolia.**—In July, Erdene Resource Development Corp. (Dartmouth, Nova Scotia, Canada) announced its Zuun Mod molybdenum project in southwestern Mongolia was officially registered with the Mongolian Mineral Resource Council, a prerequisite to applying for a mining license. In November and December 2010, the company carried out a drilling program to provide more detailed information on potential areas of high-grade mineralization to be initially developed for mining. According to the company, the data from this drill program was expected to define a more extensive prefeasibility level drill program designed to upgrade inferred resources to measured and indicated resource categories (Erdene Resource Development Corp., 2011, p. 15).

**Peru.**—The Cerro Verde Mine of FCX is an open pit copper and molybdenum mining complex 16 km southwest of Arequipa. The mine was shut down in the second quarter of 2009 owing to the economic downturn but reopened in September 2009 (Metal-Pages, 2009). In 2010, molybdenum production at Cerro Verde was approximately 3,180 t of molybdenum compared with 910 t of molybdenum in 2009 (Freeport-McMoRan Copper & Gold Inc., 2011a, p. 38).

## Outlook

The principal uses for molybdenum were expected to continue 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 and safety. Molybdenum may play a critical role in reducing sulfur in liquid fuels by acting as a cracking agent. Production of diesel fuels having ultra-low-sulfur levels was 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. The need for companies to reduce carbon dioxide emissions from coal-fired power stations will require plants to run at higher temperatures, resulting in greater demand for higher grade molybdenum-bearing steels.

In 2009–10, there were significant production cuts at copper and molybdenum producers worldwide, as well as delays and difficulties in sourcing finance, which have delayed many potential projects. Many analysts think that the molybdenum projects that are expected to commence in 2011–12 still have a significant amount of risk. For example, FCX continued construction at its Climax molybdenum mine in 2010 after halting construction in November 2008 at the height of the global financial crisis. FCX had announced a potential restart date for 2012; however, the company has been very wary of committing to a ramp-up date for Climax, owing to the risk of oversupply in the market.

During the past decade, molybdenum consumption has shown a strong annual growth rate, primarily fuelled by rapid increases in China's industrial growth. Molybdenum demand continues to be driven largely by the steel sector. The fall in stainless steel production mainly took place in developed economies. As emerging economies, such as China and India, continue on the

path to industrialization, they are expected to need increasing amounts of molybdenum, and this trend is expected to contribute to global demand growth in the coming years (Virga and Horn, 2009). The outlook for the molybdenum market in 2011 appears to be strong. Increasing steel demand, projected through at least 2015, and the potential for a whole new market from green technology were expected to contribute to increased molybdenum consumption.

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TABLE 1  
SALIENT MOLYBDENUM STATISTICS<sup>1</sup>  
(Metric tons of contained molybdenum)

	2006	2007	2008	2009	2010
United States:					
Concentrate:					
Production	59,800	57,000	55,900	47,800	59,400
Shipments	60,100	57,100	57,800	63,700	59,400
Reported consumption <sup>2</sup>	44,400	43,900	44,500	W	W
Imports for consumption	10,900	12,400	10,200	7,520	12,900
Stocks, December 31:					
Concentrate, mine and plant	2,120	2,630	1,690	2,550 <sup>r</sup>	2,200
Product producers <sup>3</sup>	3,210	3,140	3,680	3,660	W
Consumers	1,660	1,870	1,620	1,540 <sup>r</sup>	1,630
Total	6,990	7,640	6,990	7,670	3,820
Primary products:					
Production	78,000	72,800	72,900	59,900	68,600
Shipments	51,000	48,700	51,300	43,300	51,100
Reported consumption	19,000	21,000	21,100	17,700 <sup>r</sup>	19,200
World, mine production	186,000	212,000 <sup>r</sup>	218,000	221,000	242,000 <sup>e</sup>

<sup>e</sup>Estimated. <sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data.

<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	
	2009	2010	2009	2010	2009	2010
Received from other producers	--	--	W	W	W	W
Gross production during year	(3)	(3)	(3)	(3)	59,900	68,600
Molybdenum products used to make other products	W	W	W	W	W	W
Net production	(3)	(3)	(3)	(3)	33,700 <sup>r</sup>	42,100
Shipments	(3)	(3)	(3)	(3)	43,300	51,100
Producer stocks, December 31	W	W	W	W	3,660	W

<sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data. -- 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.

<sup>3</sup>Withheld to avoid disclosing company proprietary data; included in "Total."



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
2009:						
Steel:						
Carbon	427,000	297,000	--	--	W	724,000
High-strength low-alloy	W	117,000	--	--	--	117,000
Stainless and heat-resisting	2,030,000	768,000	--	(s)	90,900	2,890,000
Full alloy	3,230,000	2,500,000	--	--	W	5,730,000
Tool	382,000 <sup>r</sup>	W	--	(s)	--	382,000 <sup>r</sup>
Total	6,070,000 <sup>r</sup>	3,680,000	--	--	90,900	9,840,000 <sup>r</sup>
Cast irons (gray, malleable, ductile iron)	W	314,000	--	--	W	314,000
Superalloys	483,000	W	--	(s) <sup>r</sup>	1,010,000	1,490,000 <sup>r</sup>
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	43,300 <sup>r</sup>	--	--	3,920 <sup>r</sup>	47,200 <sup>r</sup>
Other alloys	1,020	41,700 <sup>r</sup>	--	--	W	42,700 <sup>r</sup>
Mill products made from metal powder <sup>3</sup>	W	--	--	--	W	W
Cemented carbides and related products <sup>4</sup>	--	--	--	--	77 <sup>r</sup>	77 <sup>r</sup>
Chemical and ceramic uses:						
Pigments	W	--	(s)	--	--	W
Catalysts	950,000	--	(s)	--	W	950,000
Other	--	--	--	--	W	W
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	271,000	271,000
Other	662,000 <sup>r</sup>	90,900 <sup>r</sup>	(s)	--	4,020,000 <sup>r</sup>	4,770,000 <sup>r</sup>
Grand total	8,170,000 <sup>r</sup>	4,170,000	--	--	5,390,000 <sup>r</sup>	17,700,000 <sup>r</sup>
Stocks, December 31	318,000 <sup>r</sup>	327,000 <sup>r</sup>	1,960	(6)	(6)	1,540,000 <sup>r</sup>
2010:						
Steel:						
Carbon	426,000	281,000	--	--	W	707,000
High-strength low-alloy	682,000	117,000	--	--	--	800,000
Stainless and heat-resisting	2,160,000	721,000	--	(s)	93,900	2,980,000
Full alloy	3,410,000	3,000,000	--	--	W	6,410,000
Tool	551,000	W	--	(s)	--	551,000
Total	7,230,000	4,120,000	--	--	93,900	11,400,000
Cast irons (gray, malleable, ductile iron)	W	334,000	--	--	W	334,000
Superalloys	517,000	W	--	(s)	1,240,000	1,760,000
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	48,300	--	--	W	48,300
Other alloys	1,560	73,000	--	--	W	74,500
Mill products made from metal powder <sup>3</sup>	W	--	--	--	W	W
Cemented carbides and related products <sup>4</sup>	--	--	--	--	78	78
Chemical and ceramic uses:						
Pigments	W	--	7,870	--	--	7,870
Catalysts	945,000	--	(s)	--	W	945,000
Other	--	--	--	--	3,030	3,030
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	237,000	237,000
Other	54,300	89,300	(s)	--	4,180,000	4,320,000
Grand total	8,750,000	4,670,000	7,870	--	5,750,000	19,200,000
Stocks, December 31	346,000	347,000	3,850	(6)	(6)	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.

TABLE 3—Continued

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

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

<sup>5</sup>Withheld to avoid disclosing company proprietary data; included in “Miscellaneous and unspecified uses: Other” of the “Other” category.

<sup>6</sup>Withheld to avoid disclosing company proprietary data; included in “Total.”

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

Product and country	HTS <sup>2</sup> code	2009		2010	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Oxides and hydroxides, gross weight: <sup>3</sup>	2825.70.0000				
Austria		718	\$10,400	432	\$9,560
Brazil		318	5,280	184	4,010
Canada		1,760	23,500	2,760	32,600
China		2,060	29,900	551	10,200
Germany		297	5,050	189	3,670
India		484	6,730	280	5,550
Japan		3,050	46,000	1,190	23,600
Netherlands		526	9,200	134	2,630
Turkey		74	1,400	60	1,260
United Kingdom		150	2,210	117	2,520
Other (16 countries)		1,140 <sup>r</sup>	19,500 <sup>r</sup>	150	3,640
Total		10,600	159,000	6,040	99,300
Molybdates, all, gross weight: <sup>4</sup>	2841.70.0000				
Australia		20	387	36	673
Canada		257	2,690	707	10,500
Korea, Republic of		17	266	48	375
Netherlands		411	6,370	573	7,760
United Kingdom		25	519	65	1,150
Other (28 countries)		774 <sup>r</sup>	7,740 <sup>r</sup>	250	5,730
Total		1,500	18,000	1,680	26,200
Ferromolybdenum, contained weight: <sup>4,5</sup>	7202.70.0000				
Argentina		13	353	13	507
Canada		581	16,100	677	22,300
India		65	1,550	37	1,150
Mexico		55	1,670	13	525
Netherlands		24	809	196	7,070
Other (14 countries)		86 <sup>r</sup>	1,970 <sup>r</sup>	41	1,580
Total		827	22,400	978	33,100
Molybdenum, other, gross weight: <sup>3,6</sup>	Various <sup>7</sup>				
Austria		6	374	159	10,500
Canada		84	3,090	97	4,240
Germany		137	6,280	85	4,130
Israel		63	4,950	93	7,290
Japan		363	31,800	299	29,800
Korea, Republic of		208	23,300	504	39,900
Mexico		73	4,840	110	7,380
Netherlands		1	132	123	1,820
Taiwan		76	6,630	161	11,700
United Kingdom		294	6,800	600	14,000
Other (47 countries)		477 <sup>r</sup>	23,700 <sup>r</sup>	303	22,500
Total		1,790	112,000	2,540	153,000

<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>Harmonized Tariff Schedule (HTS) of the United States.

<sup>3</sup>Presentation of annual data is based on the quantities (gross weight) of the 10 leading countries in 2010.

<sup>4</sup>Presentation of annual data is based on the quantities (gross weight) of the five leading countries in 2010.

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

<sup>6</sup>Includes powder, unwrought, waste and scrap, wire, wrought, and other.

<sup>7</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>1,2</sup>

Country	2009		2010	
	Quantity	Value	Quantity	Value
	(metric tons of contained Mo)	(thousands)	(metric tons of contained Mo)	(thousands)
Belgium	7,060	\$165,000	9,610	\$251,000
Canada	1,070	26,600	1,150	30,100
China	6,680	145,000	5,280	165,000
India	144	2,290	924	30,500
Japan	912	23,100	2,630	82,600
Korea, Republic of	884	19,900	805	26,500
Mexico	2,870	20,300	5,040	38,500
Netherlands	6,510	153,000	8,210	231,000
South Africa	431	6,340	520	10,100
United Kingdom	2,440	61,100	5,000	148,000
Other (23 countries)	591 <sup>r</sup>	7,520 <sup>r</sup>	1,410	42,400
Total	29,600	631,000	40,600	1,050,000

<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>Presentation of annual data is based on the quantities (gross weight) of the 10 leading countries in 2010.

Source: U.S. Census Bureau.

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

Item	HTS <sup>2</sup> code	2009			2010		
		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	18,200	18,000	\$397,000 <sup>r</sup>	18,800	18,800	\$574,000
Molybdenum ore and concentrates, other	2613.90.0000	11,600	11,600	238,000	21,800	21,800	484,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	10,600	NA	159,000	6,040	NA	99,300
Molybdates, all	2841.70.0000	1,500	NA	18,000	1,680	NA	26,200
Ferromolybdenum	7202.70.0000	1,200	827	22,400	1,430	978	33,100
Molybdenum powders	8102.10.0000	592	NA	21,100	509	NA	20,900
Molybdenum unwrought, bars and rods	8102.94.0000	25	NA	1,300	273	NA	11,300
Molybdenum waste and scrap	8102.97.0000	373	NA	7,010	707	NA	12,400
Molybdenum wire	8102.96.0000	155	NA	12,000	175	NA	15,200
Molybdenum, other	Various <sup>3</sup>	641	NA	70,400	872	NA	93,500
Total		44,900	NA	946,000	52,300	NA	1,370,000

<sup>r</sup>Revised. 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 (HTS) 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	2009		2010	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Oxides and hydroxides, gross weight: <sup>3</sup>	2825.70.0000				
Chile		148	\$2,360	378	\$9,510
China		20	605	16	337
Japan		23	148	2	18
Mexico		--	--	92	1,760
Uzbekistan		--	--	20	529
Other (3 countries)		18	220	(4)	3
Total		209	3,330	508	12,200
Molybdates, all, contained weight: <sup>3</sup>	Various <sup>5</sup>				
Belgium		4	587	5	771
Chile		434	14,800	468	16,000
China		198	4,270	400	11,800
Germany		--	--	39	896
Japan		17	663	15	549
Other (4 countries)		4	148	1	110
Total		657	20,500	928	30,100
Molybdenum orange, gross weight: <sup>3</sup>	3206.20.0020				
Canada		227	1,960	247	2,220
Colombia		12	64	10	49
Germany		--	--	6	29
Mexico		25	134	50	293
United Kingdom		--	--	30	78
Other (5 countries)		5	18	7	56
Total		269	2,170	350	2,730
Ferromolybdenum, contained weight: <sup>3,6</sup>	7202.70.0000				
Belgium		21	571	89	3,290
Canada		87	2,790	348	14,300
Chile		1,730	41,200	2,520	89,800
Korea, Republic of		--	--	99	3,740
United Kingdom		72	2,140	340	11,900
Other (11 countries)		115	3,400	169	6,560
Total		2,030	50,100	3,560	130,000
Other, gross weight: <sup>7</sup>	Various <sup>8</sup>				
Austria		387	18,800	334	23,200
Canada		5	526	85	3,250
China		408	15,700	1,070	43,800
Germany		59	2,530	114	6,040
Hong Kong		9	424	41	1,770
Japan		24	1,460	59	2,390
Mexico		(4)	25	25	111
Poland		--	--	40	1,680
Russia		12	1,350	28	3,130
Taiwan		(4)	42	18	697
Other (20 countries)		66	2,110	29	1,780
Total		970	43,000	1,840	87,800

-- 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>Presentation of annual data based on the quantities (gross weight) of the five leading countries in 2010.

<sup>4</sup>Less than ½ unit.

<sup>5</sup>Includes HTS codes 2841.70.1000 and 2841.70.5000.

<sup>6</sup>Ferromolybdenum contains about 60% to 65% molybdenum.

<sup>7</sup>Presentation of annual data based on the quantities (gross weight) of the 10 leading countries in 2010.

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

<sup>8</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	2009		2010	
	Quantity (metric tons of contained Mo)	Value (thousands)	Quantity (metric tons of contained Mo)	Value (thousands)
Belgium	--	--	25	\$782
Canada	2,000	\$45,700	1,620	51,300
Chile	1,910	54,100	3,000	99,200
China	--	--	(2)	3
Germany	--	--	25	935
Mexico	1,910	17,000	4,600	53,500
Peru	1,690	32,900	3,680	108,000
Total	7,520	150,000	12,900	314,000

-- Zero.

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

<sup>2</sup>Less than ½ unit.

Source: U.S. Census Bureau.

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

Item	HTS <sup>2</sup> code	2009			2010		
		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	7,780	4,800	\$94,800	10,300	6,340	\$111,569
Molybdenum ore and concentrates, other	2613.90.0000	5,590	2,720	54,900	13,500	6,610	202,102
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	209	NA	3,330	508	NA	12,162
Molybdates, all	Various <sup>3</sup>	1,170	657	20,500	1,650	928	30,129
Molybdenum orange	3206.20.0020	269	NA	2,170	349	NA	2,729
Ferromolybdenum	7202.70.0000	3,040	2,030	50,100	5,330	3,560	129,638
Molybdenum powders	8102.10.0000	60	52	2,870	232	221	10,146
Molybdenum unwrought, bars and rods	8102.94.0000	107	98	2,880	307	301	10,167
Molybdenum waste and scrap	8102.97.0000	482	473	15,300	703	682	26,944
Molybdenum wire	8102.96.0000	15	NA	2,120	19	NA	3,032
Molybdenum, other	Various <sup>4</sup>	306	NA	19,800	582	NA	37,549
Total		19,000	NA	269,000	33,500	NA	576,168

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 (HTS) 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 2010

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.
Sierrita	Pima	Freeport-McMoRan Copper & Gold Inc.	Do.
Colorado, Henderson	Clear Creek	do.	Molybdenum ore, concentrated.
Idaho, Thompson Creek	Custer	Thompson Creek Metals Co. Inc.	Do.
Montana, Continental Pit	Silver Bow	Montana Resources	Copper-molybdenum ore, concentrated.
Nevada:			
Ashdown	Humboldt	Win-Eldrich Mines Ltd.	Molybdenum ore, concentrated.
Robinson	White Pine	Quadra Mining Ltd.	Copper-molybdenum ore, concentrated.
New Mexico, Questa	Taos	Chevron Mining	Molybdenum ore, concentrated.
Utah, Bingham Canyon	Salt Lake	Kennecott Utah Copper Corp. <sup>1</sup>	Copper-molybdenum ore, concentrated.
Do., do. Ditto.			

<sup>1</sup>Wholly owned subsidiary of Rio Tinto plc.

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

(Metric tons of contained molybdenum)

Country <sup>3</sup>	2006	2007	2008	2009	2010 <sup>e</sup>
Armenia	3,900	4,080	4,250	4,150	4,150
Canada	7,712 <sup>r</sup>	6,681 <sup>r</sup>	8,602 <sup>r</sup>	8,641 <sup>r</sup>	8,261 <sup>p,4</sup>
Chile	43,278	44,912	33,687	34,925	37,186 <sup>4</sup>
China <sup>e</sup>	43,900	66,700	81,000	93,500	93,600
Iran <sup>e</sup>	2,500	3,600	3,700 <sup>r</sup>	3,700	3,700
Kazakhstan	250	400	400	380	360
Kyrgyzstan <sup>e</sup>	250	250	250	250	250
Mexico	2,519	6,159	7,812	7,800	10,853 <sup>4</sup>
Mongolia	1,404	1,978	1,899 <sup>r</sup>	3,000	2,500
Peru	17,209	16,737	16,721	12,295	16,963 <sup>4</sup>
Russia <sup>e</sup>	3,100	3,300	3,600	3,800	3,800
United States	59,800	57,000	55,900	47,800	59,400 <sup>4</sup>
Uzbekistan <sup>e</sup>	600	600	500	550	550
Total	186,000	212,000 <sup>r</sup>	218,000	221,000	242,000

<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 16, 2011.

<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.