



2020 Minerals Yearbook

MAGNESIUM [ADVANCE RELEASE]

MAGNESIUM

By E. Lee Bray

Domestic survey data and tables were prepared by Sidney W. DeLoach-Overton, statistical assistant.

U.S. reported consumption of primary magnesium in 2020 decreased by 5% compared with that in 2019 (tables 1, 3). Magnesium exports increased by 52% compared with those in 2019, and total magnesium imports for consumption increased by 4% compared with those in 2019 (table 1). Imports continued to provide a significant share of the U.S. supply of primary magnesium because there has been only one domestic producer since 2001. Since 1998, the U.S. share of the world's primary magnesium capacity has decreased to 3% from 30%. During that time period, two of the three domestic producers closed and China had more than a thirteenfold increase in capacity and production. Excluding production in the United States, worldwide primary magnesium production was 1.00 million metric tons (Mt) in 2020, 5% less than 1.06 Mt (revised) in 2019 (table 8). Production decreased by 3% in China (by 24,000 metric tons [t]), accounting for most of the decrease in global production compared with that in 2019; production also decreased in Brazil by 10% (2,000 t), Israel by 13% (2,850 t), Kazakhstan by 36% (9,000 t), Russia by 28% (19,000 t), and Ukraine by 25% (2,000 t). China, with 86% of global capacity, accounted for 88% of global production (excluding the United States) (tables 7, 8).

Import prices for magnesium generally decreased throughout 2020 in the United States. The U.S. spot dealer import price for magnesium at yearend 2020 was 18% less than that at yearend 2019. The S&P Global Platts Metals Week annual average U.S. spot Western magnesium price of \$2.49 per pound in 2020 was slightly more than the 2019 annual average price.

U.S. reported consumption of primary magnesium decreased by 5% to 48,900 t in 2020 from 51,700 t in 2019. Decreased magnesium consumption for aluminum alloys and diecastings accounted for most of the decreased consumption (table 3). Production of secondary magnesium decreased by 6% in 2020 compared with that in 2019 (tables 1, 2).

Magnesium is the eighth most abundant element in the Earth's crust and the third most plentiful dissolved element in seawater. Magnesium metal is recovered from the mineral dolomite and lake brines. Magnesium's light weight and ease of casting make it desirable for transportation products. Magnesium readily alloys with aluminum to make aluminum products stronger and easier to machine. Magnesium's strong affinity for halides, such as chlorine and fluorine, make it useful for reducing metal halides, such as those of beryllium, hafnium, titanium, uranium, and zirconium to metal. Magnesium's chemical properties also make it useful to remove sulfur from iron and steel.

This chapter discusses the magnesium metal industry which includes primary and secondary magnesium. The magnesium compounds industry is reviewed in the Magnesium Compounds chapter of the U.S. Geological Survey (USGS) Minerals Yearbook, volume I, Metals and Minerals.

Legislation and Government Programs

Sulfur hexafluoride (SF₆), a cover gas used to protect molten magnesium from oxidation, has been identified as a potential factor in global warming. The molten magnesium processes that use cover gas for melt protection are primary production; secondary production; die, permanent mold, and sand casting; wrought products production; and anode production. According to the U.S. Environmental Protection Agency (EPA), SF₆ emissions by the magnesium industry in 2020 were equivalent to 0.9 teragram of carbon dioxide (CO₂), unchanged from the amount in 2019 and less than the 1.0 teragram of CO₂ emitted in 2018. The industry continued its efforts to use SF₆ alternatives, such as Novec™ 612 (dodecafluoro-2-methyl-3-pentanone), hydrofluorocarbon-134a (HFC-134a), and sulfur dioxide as part of the industry's and EPA's partnership. However, the use of SF₆ alternatives did not increase during 2020, as compared with that in 2015. Emissions of HFC-134a in 2020 were equivalent to 0.1 teragram of CO₂, unchanged from the amounts since 2015. These alternatives have lower global warming potential than SF₆ and tend to decompose quickly during their exposure to the molten metal. The long atmospheric life (about 3,000 years) of SF₆ and its high potential as a greenhouse gas (23,900 times the global warming potential of CO₂) resulted in a call for voluntary reductions in emissions. In 1999, the U.S. magnesium industry, the International Magnesium Association, and the EPA began a voluntary partnership to reduce SF₆ emissions (U.S. Environmental Protection Agency, 2019, p. 4–86 to 4–90; 2020, p. 4–96 to 4–101; 2021, p. 4–99 to 4–104; 2022b, p. 4–104 to 4–110).

In 2008, the EPA listed the magnesium production facility at Rowley, UT, owned by US Magnesium LLC (Salt Lake City, UT) as a Superfund site. US Magnesium appealed the decision but, in January 2011, the U.S. Circuit Court of Appeals for the District of Columbia denied the appeal. US Magnesium had argued that the EPA had overestimated the risk of pollutants from the facility entering the air and soil. Designation of the facility as a Superfund site gave the EPA the authority to further investigate the site to determine if a cleanup was necessary. The designated site encompasses 1,830 hectares (4,530 acres) on the southwest edge of the Great Salt Lake. The EPA completed sampling in September 2015 as part of a site study. A report of the results was published in October 2016, but cleanup activities had not started by yearend 2020 (Fahys, 2011; U.S. Environmental Protection Agency, 2022a).

Production

Because there was only one primary magnesium producer operating in the United States, production data were withheld by the USGS to avoid disclosing company proprietary data. US Magnesium, the sole producer of primary magnesium in the

United States, recovered magnesium electrolytically from brines harvested from the Great Salt Lake at its 63,500-metric-ton-per-year (t/yr) plant in Rowley, UT.

Secondary magnesium ingot was produced from scrap by two companies in the United States—Advanced Magnesium Alloys Corp. (Anderson, IN) and MagPro LLC (Camden, TN). Magnesium scrap also was consumed at a foundry by Meridian Magnesium Products Co. in Eaton Falls, MI. Magnesium contained in aluminum alloy scrap was recovered at numerous secondary aluminum smelters. Domestic secondary magnesium metal recovery from magnesium-base and aluminum-base scrap decreased by 6% compared with that in 2019. About 65% of the secondary magnesium recovered was contained in aluminum alloys, and about 36% was contained in magnesium alloy castings, ingot, and other forms (table 2).

Western Magnesium Corp. selected a site to construct a pilot plant to test magnesium production from dolomite by a process it had developed. Permits for construction of the pilot plant were obtained in November from the municipality where the plant would be located. If the pilot plant proves the process to be economically competitive, a commercial-scale 30,000-t/yr magnesium smelter would be planned. Equipment for the pilot plant was ordered with some deliveries completed by November, but suppliers cited disruptions caused by the global coronavirus disease 2019 (COVID-19) pandemic for delayed deliveries of some equipment. A construction schedule was not available, and the location was not disclosed by the company (Western Magnesium Corp., 2020a, b).

Consumption

Data for magnesium metal consumption were collected from two voluntary surveys of U.S. operations by the USGS. Of the 42 companies canvassed for magnesium consumption data, 43% responded, representing about 60% of the magnesium-base scrap consumption reported in table 2 and the primary magnesium consumption reported in table 3. Data for the 24 nonrespondents were estimated based on prior-year consumption levels and other information.

Reported primary magnesium consumption in 2020 decreased by 5% compared with that in 2019, which was attributed to decreased consumption for aluminum alloys by 7% and for diecastings by 3% (table 3). Decreased primary magnesium consumption in aluminum alloys corresponded to decreased primary and secondary aluminum production, which were 7% and 12% less, respectively, than that in 2019. The principal applications for primary magnesium in the United States in 2020 were diecasting (45%), alloying aluminum (31%), and desulfurization of iron and steel (15%) (table 3). Consumption of secondary magnesium in castings decreased slightly compared with that in 2019 (table 2). Decreased consumption of primary and secondary magnesium in castings was attributed to decreased automobile production compared with that in 2019. Total light-vehicle sales in the United States in 2020 equaled 14.47 million units, 15% less than the 16.96 million units in 2019. Production of vehicles in the United States was 1.92 million units in 2020, 23% less than the 2.51 million units in 2019 (Bureau of Economic Analysis, 2021).

Secondary magnesium recovery decreased by 6% compared with that in 2019. Secondary magnesium recovered from aluminum-base scrap decreased by 9% compared with that in 2019. Secondary magnesium recovery from new aluminum-base scrap decreased by 11% (3,820 t) compared with that in 2019. Decreased manufacturing attributed to COVID-19 pandemic-related restrictions, especially in the aerospace and automobile sectors, was cited for decreased new aluminum scrap generated by manufacturers in 2020. Recovery of secondary magnesium from old aluminum scrap decreased by 6% (1,260 t) compared with that in 2019. Recovery of secondary magnesium scrap from castings in 2020 decreased slightly to 39,200 t (table 2).

Prices

The S&P Global Platts Metals Week U.S. spot Western magnesium price range was \$2.70–\$2.90 per pound at the beginning of the year but decreased to \$2.35–\$2.55 per pound by July. By August it was \$2.30–\$2.35 per pound, where it remained for the rest of the year. The annual average price of \$2.49 per pound in 2020, slightly more than the annual average price in 2019. According to traders and producers, however, U.S. spot Western prices were not representative of the prices paid for most magnesium consumed, as nearly all primary magnesium was purchased through annual contracts (Cowden, 2013; McBeth, 2013, 2014).

Contract negotiations for deliveries in 2020 generally were delayed until December 2019 as most buyers, brokers, and producers waited for the ruling on the antidumping and countervailing duty investigation of imports from Israel. Although contracted prices for pure magnesium ranged from \$2.40 per pound to \$2.75 per pound, only a few contracts were made at the low end of the range, and most were at \$2.60 per pound. Contract prices for magnesium produced in the United States and other countries were similar. Many consumers reported increasing their share of secondary magnesium in their 2020 purchase plans, citing the increased prices for pure primary magnesium. Once the final determination was made in November 2019 that imports from Israel had not caused injury to the industry in the United States, prices decreased slowly after the duties were removed from imports produced by Dead Sea Magnesium Ltd. During the last part of December, spot prices for pure magnesium decreased to about \$2.35 per pound from \$2.45 per pound (McBeth, 2019c, d, 2020g; U.S. Department of Commerce, International Trade Administration, 2019).

Magnesium prices for contracted delivery in 2021 signed in the fourth quarter of 2020 tended to be lower than spot prices at the same time that contracts were signed. Large volume contract prices ranged between \$1.60 per pound and \$1.80 per pound. Small volume contract prices ranged between \$1.90 per pound and \$2.00 per pound. Several traders and consumers reported that the lower contract price was contingent upon exclusive supply agreements, which many consumers were unwilling to accept. Contract offers for secondary magnesium alloy ranged between \$1.55 per pound and \$1.60 per pound for 90% magnesium, 10% aluminum. Offers for secondary magnesium alloy with 95% magnesium, 5% aluminum ranged between \$1.60 per pound and \$1.70 per pound (McBeth, 2020e, i).

The U.S. spot dealer prices for imported magnesium ranged from \$2.45 per pound to \$2.65 per pound at the beginning of January to \$2.00 per pound to \$2.15 per pound at the end of December. The annual average spot dealer import magnesium price was \$2.26 per pound, 3% less than that in 2019. After the removal of antidumping and countervailing duties on magnesium from Israel by the U.S. International Trade Commission in November 2019, import supply increased during the first quarter of 2020 and prices decreased (McBeth, 2019d, 2020g, h).

The annual average magnesium price in Europe was \$2,149 per metric ton, 11% less than that in 2019. The monthend average magnesium price in Europe in February spiked to \$2,550 per metric ton because of concerns regarding supply shortages as many producers in China were ordered to shut down temporarily and transportation was halted in response to the COVID-19 pandemic. However, the monthend average price in Europe dropped in March to \$2,175 per metric ton when magnesium producers in China restarted production and many secondary aluminum producers and diecasters temporarily shut down, decreasing demand. Prices generally decreased through the end of October when the monthend average price was \$2,000 per metric ton. During the last 3 months of the year, the price increased, with the December monthend price reaching \$2,625 per metric ton because of concerns regarding supply shortages. A shortage of shipping containers and delays in shipments were cited for price increases in Europe in the later part of the year. A plan to stockpile magnesium in Yulin, Shaanxi Province, China also was cited for the increase in prices in China and Europe at the end of the year. Prices in Europe generally followed the trend of prices in China, which was the source of most magnesium consumed in Europe (McBeth, 2020b–f).

Foreign Trade

Total U.S. magnesium exports in 2020 were 52% more than those in 2019 (table 5). Canada (65%) and Mexico (9%) were the leading destinations. In 2020, exports of magnesium metal and scrap increased by 404% and 147%, respectively. Exports of semifabricated products and alloys decreased by 19% and 34%, respectively, from those in 2019. Total magnesium imports for consumption in 2020 were 4% more than those in 2019 (table 6). Turkey was the leading source of imported magnesium metal, accounting for 46% of the total, followed by Russia (26%) and Israel (18%). Austria, Mexico, China, and Canada supplied 27%, 18%, 16%, and 16%, respectively, of semifabricated magnesium product imports in 2020. Since 2001, when the United States imposed antidumping duties on magnesium from China, only minor amounts of primary magnesium ingot have been imported from China; however, China supplied 16% of semifabricated magnesium products to the United States in 2020. Taiwan was the leading supplier of imported magnesium alloys (36%), followed by Hungary (15%), Czechia (14%), and Germany (11%). Scrap accounted for 39% of total magnesium imports; Canada (38%), China (21%), and Mexico (18%) were the leading sources of scrap imports.

World Review

Global production of primary magnesium (excluding the United States) equaled 1.00 Mt, 5% less than the revised amount produced in 2019 (table 8).

Australia.—In September, Latrobe Magnesium Ltd. received approval from the Environment Protection Authority Victoria to construct a pilot plant in the Latrobe Valley, Victoria. The pilot plant would produce magnesium from fly ash having a high magnesium content, and its capacity would be 3,000 t/yr. Construction was expected to begin in 2022, and initial production would start about 18 months later. Future expansion to 40,000 t/yr was being considered (Latrobe Magnesium Ltd., 2020, p. 22; 2021).

Canada.—In June, Alliance Magnesium Inc. started construction of the first phase of a smelter in Asbestos, Quebec, to produce primary magnesium from asbestos mine tailings and a secondary magnesium plant. Production of secondary magnesium was expected by midyear 2021, and primary magnesium production was expected in 2022. Both plants would have a combined capacity of 18,000 t/yr. Expansion of the plants to 50,000 t/yr was planned (Alliance Magnesium Inc., 2020; Lazzaro, 2020; McBeth, 2020a).

China.—China's magnesium production was 886,000 t in 2020, 3% less than the revised amount in 2019 (table 8). Magnesium consumption in China was estimated to be 485,000 t in 2020. Total exports of magnesium, including ingot, alloys, and powder were estimated to be 380,000 t (Leung, 2021). Many magnesium producers decreased production in January and February 2020 in response to the COVID-19 pandemic and heavy snow in the northwest part of the country. Workers returning from the spring festival holiday were required to quarantine for 14 days after traveling, decreasing labor availability at smelters. Road closures in response to the COVID-19 pandemic were cited for shortages of raw materials at some magnesium smelters. In early March, some smelters restarted production. Despite the decreased production, many producers and traders had sufficient stocks during the first quarter of the year to meet demand, minimizing shortages. In January and February, production in China was 115,100 t, 7.3% less than that in the same period in 2019. In the first 2 months of the year, production from Shaanxi Province was 14,900 t, 29% less than that of the same period in 2019, although production in Shaanxi Province increased by 7.5% to 81,200 t in the same period. Exports from China in January and February were 61,700 t, 20% less than that of the first 2 months in 2019. Some capacity was restarted later in the year, and the production total for January through July was 465,400 t, 3.7% less than that of the same period in 2019. Production from January through July in Shaanxi Province was 62,700 t, 17% less than that in the same period of 2019. Production from January through July in Shaanxi Province and Ningxia Autonomous Region increased by about 7% each to 306,500 t and 27,700 t, respectively (Leung, 2020a, c, d).

In June, the municipal government of Yulin, Shaanxi Province, announced that it would purchase and stockpile magnesium to maintain production at smelters in the Province

during the COVID-19 pandemic. By December, approximately 10,000 t of magnesium was stockpiled, according to traders familiar with the market in China. Shaanxi Province was a leading magnesium-producing Province in China (Leung, 2020b; McBeth, 2020b).

Qinghai Salt Lake Magnesium Co. Ltd. (QSLM) continued to experience production issues throughout the year at its 100,000-t/yr smelter in Golmud, Qinghai Province, that was designed to produce magnesium from lake brines. Production was halted in April 2019 after technical issues resulted in low volumes of magnesium produced and magnesium that did not meet specifications because of contamination by nickel. Engineering inspections of the smelter were conducted to identify and correct the source of nickel contamination and other problems, but production was not restarted by yearend 2020 because of financial issues. Work on the plant to correct the issues was delayed until 2021 because of the financial situation. Qinghai Salt Lake Industry Co. Ltd. (QSLIC), the parent company of QSLM, entered a restructuring plan in August 2019. On December 31, 2019, Qinghai Huixin Asset Management Co. Ltd. acquired all non-potassium assets of QSLIC, including QSLM. The legal restructuring of the company under new ownership was completed in December 2020 (Magontec Ltd., 2020a, p. 2–3, 6–7; 2020b).

Turkey.—Production increased to 12,000 t, 71% more than the 7,000 t in 2019, because of a full year of production after the restart of the primary magnesium plant in Eskisehir in May 2019 (table 8). The 15,000-t/yr smelter, previously owned by Esan Eczacıbaşı Endüstriyel Hammaddeler San. Ve Tic. A.Ş., shut down in May 2018 but reopened after being purchased by Kar Maden San. Ve Tic. A.Ş. By mid-July 2019 the plant was producing at a rate of about 9,000 t/yr and was estimated to be producing at a rate of about 12,000 t/yr by yearend 2019, with production estimated to be near full capacity by midyear 2020 (McBeth, 2018, 2019a, b).

Outlook

World consumption of magnesium in 2021 is expected to increase with increased economic activity. Consumption of magnesium for primary aluminum alloys in the United States is expected to decrease in 2021 compared with that in 2020 because Alcoa Corp. shut down production from its smelter in Ferndale, WA, in July 2020 (Alcoa Corp., 2020, p. 1, 3). Magnesium consumption in the United States by secondary aluminum smelters is expected to increase in 2021 compared with that in 2020 as smelters resumed production after temporary shutdowns during the first quarter of 2020 in response to the COVID-19 pandemic. Magnesium consumption by the aluminum industry in other countries is expected to continue to follow the trend of aluminum production.

In the short term, automobile production is expected to decline in 2021 as supplies of computer chips used in many automobile models made in the United States are reported to be in short supply. Several assembly lines reported short-term shutdowns until chip inventories could be replenished. This is expected to have an impact on magnesium shipments to the transportation sector. Magnesium consumption per vehicle by the domestic automobile industry is expected to continue to

increase as automobile manufacturers substitute magnesium castings for aluminum and steel castings in more models. Many automobile manufacturers plan to continue increasing fuel efficiency, and substitution of aluminum alloyed with magnesium for steel is expected to be important to increasing fuel efficiency (Janson, 2020).

Consumption of magnesium by the iron and steel industry is expected to increase by about 4% in 2021 compared with that in 2020, based on steel production growth (World Steel Association AISBL, 2022).

References Cited

- Alcoa Corp., 2020, Alcoa Corporation reports first quarter 2020 results: Pittsburgh, PA, Alcoa Corp. press release, April 22, 14 p. (Accessed April 22, 2020, at <https://news.alcoa.com/press-releases/press-release-details/2020/Alcoa-Corporation-Reports-First-Quarter-2020-Results/default.aspx?msclkid=ad3cbc8fb1e11eca4167b0cd6b9e3de>.)
- Alliance Magnesium Inc., 2020, Alliance Magnesium completes near to \$145 million in funding for its commercial demonstration phase: Brossard, Quebec, Canada, Alliance Magnesium Inc. press release, March 13. (Accessed June 1, 2020, at <https://alliancemagnesium.com/en/alliance-magnesium-completes-near-to-145-million-in-funding-for-its-commercial-demonstration-phase/>.)
- Bureau of Economic Analysis, 2021, Auto and truck seasonal adjustment: Washington, DC, Bureau of Economic Analysis press release, June 25. (Accessed July 1, 2021, at https://apps.bea.gov/national/xls/gap_hist.xlsx.)
- Cowden, Michael, 2013, Magnesium prices steady in quiet market: American Metal Market, v. 121, no. 10–2, March 5, p. 5.
- Fahys, Judy, 2011, Court—Utah company belongs on Superfund list: Salt Lake Tribune [Salt Lake City, UT], January 14. (Accessed January 18, 2011, at <http://www.sltrib.com/sltrib/home/51052941-76/magnesium-epa-company-site.html.csp>.)
- Janson, Nick, 2020, Auto demand for aluminum to continue to grow—DruckerFrontier: S&P Global Platts Metals Daily, v. 9, no. 14, January 21, p. 5–6.
- Latrobe Magnesium Ltd., 2020, Investment presentation AGM December 2020: Sydney, New South Wales, Australia, Latrobe Magnesium Ltd. press release, December 23, 26 p. (Accessed January 26, 2021, via <https://latrobemagnesium.com/investor-center/investor-presentations>.)
- Latrobe Magnesium Ltd., 2021, Quarterly activities report 31 December 2020: Sydney, New South Wales, Australia, Latrobe Magnesium Ltd. press release, January 25, 2 p. (Accessed January 26, 2022, via <http://latrobemagnesium.com/investor-center/announcements>.)
- Lazzaro, Nick, 2020, Alliance starts building Quebec Mg plant; eyes Q1 2021 output: S&P Global Platts Metals Daily, v. 9, no. 127, June 30, p. 14.
- Leung, Joshua, 2020a, China's Jan-Feb magnesium output dips 7% on coronavirus spread: S&P Global Platts Metals Daily, v. 9, no. 78, April 21, p. 8.
- Leung, Joshua, 2020b, China's Yulin city looks to build magnesium reserves amid virus: S&P Global Platts Metals Daily, v. 9, no. 110, June 5, p. 8.
- Leung, Joshua, 2020c, Chinese magnesium sector weak in September; faces pressure from stocks, cash flow: S&P Global Platts Metals Daily, v. 9, no. 188, September 23, p. 4.
- Leung, Joshua, 2020d, Snow, coronavirus squeeze spot magnesium supply in China—CNIA: S&P Global Platts Metals Daily, v. 9, no. 43, March 2, p. 1, 4.
- Leung, Joshua, 2021, China's 2021 magnesium demand seen rising to 503,500 mt on downstream support: S&P Global Platts Metals Daily, v. 10, no. 10, January 15, p. 6.
- Magontec Ltd., 2020a, Annual report 2019: Potts Point, New South Wales, Australia, Magontec Ltd., 78 p. (Accessed February 4, 2021, at <https://onlinereports.irmau.com/2019/MGL/>.)
- Magontec Ltd., 2020b, QSLM presentation and speech at China Magnesium Association conference: Potts Point, New South Wales, Australia, Magontec Ltd. press release, September 23. (Accessed February 2, 2022, via <http://magontec.com/investor-centre/asx-announcements/>.)
- McBeth, Karen, 2013, US magnesium sees wide ranges with little spot activity: S&P Global Platts Metals Daily, v. 2, no. 33, February 15, p. 5–6.
- McBeth, Karen, 2014, Magnesium spot stability carries through to 2015 deals: S&P Global Platts Metals Daily, v. 3, no. 253, December 24, p. 5–6.

- McBeth, Karen, 2018, Dead Sea tells ITC US Magnesium's injury was not from its imports: S&P Global Platts Metals Daily, v. 7, no. 225, November 14, p. 1, 6–7.
- McBeth, Karen, 2019a, European magnesium reflects Chinese dip; US prices stable: S&P Global Platts Metals Daily, v. 8, no. 102, May 24, p. 1, 12–13.
- McBeth, Karen, 2019b, Turkish magnesium plant sends first US shipment to offset potential supply shortfall: S&P Global Platts Metals Daily, v. 8, no. 141, July 19, p. 1, 8–9.
- McBeth, Karen, 2019c, US magnesium prices seen supported despite no duties for Israeli imports—Market sources: S&P Global Platts Metals Daily, v. 8, no. 249, December 18, p. 1, 11.
- McBeth, Karen, 2019d, US magnesium prices steady on light spot market activity: S&P Global Platts Metals Daily, v. 8, no. 246, December 13, p. 8.
- McBeth, Karen, 2020a, Alliance Magnesium aims to sell secondary magnesium in Q2 2021: S&P Global Platts Metals Daily, v. 9, no. 210, October 23, p. 8–9.
- McBeth, Karen, 2020b, Europe magnesium prices surge; US prices stable for now: S&P Global Platts Metals Daily, v. 9, no. 250, December 18, p. 6–7.
- McBeth, Karen, 2020c, Magnesium prices fall in Europe; US demand seen weakening: S&P Global Platts Metals Daily, v. 9, no. 76, April 17, p. 9–10.
- McBeth, Karen, 2020d, Magnesium prices in Europe, US weaken on light bookings: S&P Global Platts Metals Daily, v. 9, no. 87, May 4, p. 1, 13.
- McBeth, Karen, 2020e, Soaring magnesium prices and shipping issues affect Europe, US: S&P Global Platts Metals Daily, v. 9, no. 240, December 4, p. 5–6.
- McBeth, Karen, 2020f, US, Europe magnesium prices stable; excess supply seen: S&P Global Platts Metals Daily, v. 9, no. 110, June 5, p. 8–10.
- McBeth, Karen, 2020g, US magnesium prices moderate but remain supported: S&P Global Platts Metals Daily, v. 9, no. 3, January 6, p. 4–5.
- McBeth, Karen, 2020h, US magnesium prices weaken as demand inertia sets in: S&P Global Platts Metals Daily, v. 9, no. 120, June 19, p. 10.
- McBeth, Karen, 2020i, US spot magnesium prices pressured by 2021 contract competition, US: S&P Global Platts Metals Daily, v. 9, no. 220, November 6, p. 7–8.
- U.S. Department of Commerce, International Trade Administration, 2019, Magnesium from Israel—Final affirmative countervailing duty determination: Federal Register, v. 84, no. 230, November 29, p. 65785–65787. (Accessed November 29, 2019, at <https://www.govinfo.gov/content/pkg/FR-2019-11-29/pdf/2019-25891.pdf>.)
- U.S. Environmental Protection Agency, 2019, Inventory of U.S. greenhouse gas emissions and sinks—1990–2017: U.S. Environmental Protection Agency 430–R–19–001, April 11, 675 p. (Accessed February 4, 2020, at <https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-main-text.pdf>.)
- U.S. Environmental Protection Agency, 2020, Inventory of U.S. greenhouse gas emissions and sinks—1990–2018: U.S. Environmental Protection Agency 430–R–20–002, April 13, 733 p. (Accessed March 14, 2020, at <https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf>.)
- U.S. Environmental Protection Agency, 2021, Inventory of U.S. greenhouse gas emissions and sinks—1990–2019: U.S. Environmental Protection Agency 430–R–21–005, April 14, 733 p. (Accessed December 17, 2021, at <https://www.epa.gov/sites/production/files/2021-04/documents/us-ghg-inventory-2021-main-text.pdf>.)
- U.S. Environmental Protection Agency, 2022a, EPA Superfund Program—US Magnesium, Tooele County, UT: U.S. Environmental Protection Agency. (Accessed January 3, 2022, at <https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0802704>.)
- U.S. Environmental Protection Agency, 2022b, Inventory of U.S. greenhouse gas emissions and sinks—1990–2020: U.S. Environmental Protection Agency 430–R–21–003, April 15, variously paged. (Accessed December 14, 2022, at <https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-main-text.pdf>.)
- Western Magnesium Corp., 2020a, Operational update: New York, NY, Western Magnesium Corp. press release, November 19. (Accessed January 20, 2022, at <https://westernmagnesium.com/operational-update-4/>.)
- Western Magnesium Corp., 2020b, Western Magnesium obtains pilot plant location: New York, NY, Western Magnesium Corp. press release, September 1. (Accessed January 22, 2022, at <https://www.westernmagnesium.com/news/western-magnesium-obtains-pilot-plant-location>.)
- World Steel Association AISBL, 2022, Total production of crude steel: Brussels, Belgium, World Steel Association AISBL. (Accessed January 29, 2022, at <https://worldsteel.org/media-centre/press-releases/2022/january-2022-crude-steel-production/#:~:text=Table%201.%20Crude%20steel%20production%20by%20region%20,%20%20-6.8%20%205%20more%20rows%20?msclkid=1abf0f73b1de11ecbcc8123707673116>.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- Evaporites and Brines. Ch. in *United States Mineral Resources*, Professional Paper 820, 1973.
- Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.
- Magnesian Refractories. Ch. in *United States Mineral Resources*, Professional Paper 820, 1973.
- Magnesium. Mineral Industry Surveys, quarterly.
- Magnesium, Its Alloys and Compounds. Open-File Report 01–341, 2001.
- Magnesium Metal. Ch. in *Mineral Commodity Summaries*, annual.
- Magnesium (Mg). Ch. in *Metal Prices in the United States Through 2010*, Scientific Investigations Report 2012–5188, 2013.
- Magnesium Recycling in the United States in 1998. Circular 1196–E, 2004.
- Other**
- Economics of Magnesium Metal, The (12th ed.). Roskill Information Services Ltd., 2016.
- Magnesium. Ch. in *Mineral Facts and Problems*, U.S. Bureau of Mines Bulletin 675, 1985.
- Magnesium and Magnesite in the CIS in 1996. Roskill Information Services Ltd., 1996.

TABLE 1
SALIENT MAGNESIUM STATISTICS¹

(Metric tons unless otherwise specified)

	2016	2017	2018	2019	2020	
United States:						
Production:						
Primary	W	W	W	W	W	
Secondary	101,000	112,000	109,000	101,000	94,800	
Exports	19,300	13,700	12,300	9,770	14,900	
Imports for consumption	45,500	41,900	46,500	58,800	61,200	
Consumption, primary, reported	69,000	65,500	50,700	51,700	48,900	
Yearend stocks, producer	W	W	W	W	W	
Yearend price range ²	dollars per pound	2.10–2.20	2.10–2.20	2.20–2.30	2.70–2.90	2.30–2.35
Annual average price ²	do.	1.56	1.45	1.57	2.32	2.26
World, primary production ^{3,4}	993,000	1,050,000	1,000,000	1,060,000 ^r	1,000,000	

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

¹Table includes data available through November 22, 2021. Data are rounded to no more than three significant digits.

²Source: S&P Global Platts Metals Week.

³Does not include U.S. production.

⁴May include estimated data.

TABLE 2
MAGNESIUM RECOVERED FROM SCRAP PROCESSED IN THE
UNITED STATES, BY KIND OF SCRAP AND FORM OF RECOVERY¹

(Metric tons)

	2019	2020
KIND OF SCRAP		
New scrap:		
Magnesium-base	39,600	39,200
Aluminum-base	34,900	31,100
Total	74,500	70,300
Old scrap:		
Magnesium-base	6,640	6,360
Aluminum-base	19,400	18,200
Total	26,100	24,500
Grand total	101,000	94,800
FORM OF RECOVERY		
Magnesium alloy ingot ²	W	W
Magnesium alloy castings	33,300	32,900
Aluminum alloys	66,400	61,300
Other ³	890	569
Total	101,000	94,800

W Withheld to avoid disclosing company proprietary data; included in "Other."

¹Table includes data available through July 27, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes secondary magnesium content of both secondary and primary alloy ingot.

³Includes chemical and other dissipative uses, cathodic protection, and data indicated by W.

TABLE 3
U.S. CONSUMPTION OF PRIMARY MAGNESIUM, BY USE¹

(Metric tons)

Use	2019	2020
For structural products:		
Castings:		
Die	23,000	22,000
Permanent mold	540	540
Sand	1,450	1,410
Wrought products ²	W	W
Other	206	206
Total	25,200	24,100
For distributive or sacrificial purposes:		
Aluminum alloys	16,400	15,200
Cathodic protection (anodes)	(3)	(3)
Iron and steel desulfurization	7,170	7,170
Nodular iron	474	321
Reducing agent for titanium and other metals	1,500	1,090
Other ⁴	984	996
Total	26,500	24,800
Grand total	51,700	48,900

W Withheld to avoid disclosing company proprietary data; included in "For structural products: Other."

¹Table includes data available through July 27, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes sheet and plate and forgings.

³Withheld to avoid disclosing company proprietary data; included in "For distributive or sacrificial purposes: Other."

⁴Includes chemicals and scavenger, deoxidizer, powder, and data indicated by W.

TABLE 4
YEAREND MAGNESIUM PRICES

(Dollars per pound)

	2019	2020
U.S. spot dealer import	2.45–2.65	2.00–2.15
U.S. spot Western	2.70–2.90	2.30–2.35
European free market	0.95–0.99	1.16–1.22
do. Ditto.		

Source: S&P Global Platts Metals Week.

TABLE 5
U.S. EXPORTS OF MAGNESIUM, BY COUNTRY OR LOCALITY¹

(Metric tons, gross weight, and thousand dollars)

Country or locality	Waste and scrap		Metal		Alloys		Powder, sheets, tubing, ribbons, wire, other forms	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
2019:								
Brazil	6	\$15	--	--	1,060	\$3,220	42	\$161
Canada	190	355	1,350	\$5,020	2,170	7,180	440	9,470
China	--	--	1	65	--	--	36	2,140
France	--	--	11	3,950	--	--	35	5,080
Japan	--	--	2	23	2	20	27	1,050
Korea, Republic of	58	75	2	99	(2)	6	85	295
Mexico	28	91	21	93	1,120	3,620	1,400	12,400
Singapore	--	--	48	12,400	--	--	5	706
United Kingdom	--	--	(2)	180	8	37	116	3,350
Other	651	947	7	80	104	364	754	6,380
Total	933	1,480	1,440	21,900	4,460	14,400	2,940	41,000
2020:								
Australia	--	--	--	--	--	--	204	902
Brazil	19	41	--	--	193	592	27	98
Canada	29	69	7,200	18,400	2,090	6,840	353	6,050
China	19	37	2	88	13	45	37	3,140
Czechia	863	1,190	--	--	--	--	6	237
France	--	--	4	1,440	3	9	9	1,110
Israel	--	--	2	55	1	4	251	1,150
Japan	--	--	--	--	3	15	54	738
Korea, Republic of	77	155	9	91	21	74	254	1,480
Mexico	66	153	6	184	590	1,610	739	17,200
Romania	--	--	--	--	--	--	207	793
Singapore	--	--	16	4,030	--	--	1	28
Taiwan	85	138	--	--	--	--	1	27
United Kingdom	--	--	(2)	10	--	--	79	2,390
Other	1,140	1,500	9	49	41	217	145	5,610
Total	2,300	3,280	7,250	24,400	2,950	9,410	2,370	40,900

-- Zero.

¹Table includes data available through July 12, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM, BY COUNTRY OR LOCALITY¹

Country or locality	Waste and scrap		Metal		Alloys		Powder, sheets, tubing, ribbons, wire, other forms	
	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, Mg content)	Value (thousands)	Quantity (metric tons, Mg content)	Value (thousands)
2019:								
Canada	11,600	\$30,300	929	\$1,370	30	\$107	736	\$3,640
China	4,890	10,800	149	442	44	179 ^r	478	6,800
Germany	1,290	1,480	--	--	1,580	6,400 ^r	68	181
Israel	18	11	5,700	23,100	237	1,070	--	--
Japan	--	--	--	--	90	296	8	158
Kazakhstan	--	--	503	1,670	--	--	--	--
Mexico	5,530	7,680	20	32	--	--	762 ^r	3,780 ^r
Russia	--	--	4,210	12,900	--	--	1	24
Taiwan	1,650	3,290	--	--	3,660	12,200	270	1,030
Turkey	199	254	3,150	10,200	--	--	143	414
United Kingdom	156	139	--	--	886	14,600	76	9,310
Other	6,790	13,700	561	2,220	1,740 ^r	5,690 ^r	664 ^r	4,230
Total	32,100	67,500	15,200	51,800	8,260 ^r	40,400 ^r	3,210 ^r	29,600
2020:								
Austria	--	--	--	--	738	2,320	915	3,990
Canada	9,100	22,100	763	1,070	15	57	532	3,200
China	4,940	10,200	25	81	50	157	542	4,550
Czechia	273	687	18	56	2,110	6,650	--	--
France	112	247	--	--	--	--	--	--
Germany	577	416	--	--	1,650	8,220	72	311
Hungary	--	--	--	--	2,280	8,190	--	--
Israel	--	--	3,380	23,400	704	7,980	--	--
Japan	14	14	(2)	6	--	--	4	62
Kazakhstan	--	--	686	2,900	--	--	--	--
Korea, Republic of	295	164	--	--	1,060	3,450	63	834
Mexico	4,180	10,400	--	--	--	--	600	3,370
Russia	--	--	4,780	17,900	--	--	(2)	3
Taiwan	1,590	3,640	--	--	5,550	17,200	452	1,760
Turkey	--	--	8,600	37,500	--	--	--	--
United Kingdom	35	33	2	39	661	10,000	94	8,080
Other	2,680	4,820	332	1,560	582	1,820	117	1,040
Total	23,800	52,800	18,600	84,500	15,400	66,100	3,390	27,200

^rRevised. -- Zero.

¹Table includes data available through July 12, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than ½ unit.

Source: U.S. Census Bureau; data adjusted by the U.S. Geological Survey.

TABLE 7
WORLD ANNUAL PRIMARY MAGNESIUM
PRODUCTION CAPACITY, DECEMBER 31, 2020¹

(Metric tons)

Country or locality	Capacity
Brazil ^c	20,000
China ^c	1,800,000
Iran	6,000
Israel	34,000
Kazakhstan ^c	30,000
Korea, Republic of	10,000
Malaysia	15,000
Russia ^c	81,000
Serbia	5,000
Turkey	15,000
Ukraine ^c	22,000
United States	63,500
Total	2,100,000

^cEstimated.

¹Table includes capacity at operating plants as well as at plants on standby basis. Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 8
MAGNESIUM: PRIMARY WORLD PRODUCTION, BY COUNTRY OR LOCALITY¹

(Metric tons)

Country or locality	2016	2017	2018	2019	2020
Brazil ^c	16,000	20,000	20,000 ^r	20,000 ^r	18,000
China	872,800	904,600	863,000	910,000 ^r	886,000
Iran ^c	2,000	3,000	1,000	--	--
Israel	22,548	23,000	21,000	21,350 ^r	18,500
Kazakhstan ^{c, 2}	10,000	12,000	17,000	25,000	16,000
Russia ²	58,900	65,000	67,000	67,000	48,000
Turkey ^c	3,750	14,000	4,000	7,000	12,000
Ukraine ^{c, 2}	6,770	7,300	7,000	8,000	6,000
United States	W	W	W	W	W
Total	993,000	1,050,000	1,000,000	1,060,000 ^r	1,000,000

^cEstimated. ^rRevised. W Withheld to avoid disclosing proprietary data; not included in total. -- Zero.

¹Table includes data available through November 22, 2021. All data are reported unless otherwise noted; totals may include estimated data. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Includes magnesium consumed for titanium sponge production.