

## MAGNESIUM METAL<sup>1</sup>

(Data in thousand metric tons unless otherwise noted)

**Domestic Production and Use:** In 2018, primary magnesium was produced by one company in Utah at an electrolytic process plant that recovered magnesium from brines from the Great Salt Lake. Secondary magnesium was recovered from scrap at plants that produced magnesium ingot and castings, and from aluminum alloy scrap at secondary aluminum smelters. Primary magnesium production in 2018 was estimated to have been unchanged from that of 2017. Information regarding U.S. primary magnesium production was withheld to avoid disclosing company proprietary data. The leading use for primary magnesium metal, which accounted for 45% of reported consumption, was in castings, principally used for the automotive industry. Aluminum-base alloys that were used for packaging, transportation, and other applications accounted for 25% of primary magnesium metal consumption; desulfurization of iron and steel, 11%; reduction agent for metals production, 10%; and other uses, 9%. About 35% of the secondary magnesium was consumed for structural uses and about 65% was used in aluminum alloys.

| <b>Salient Statistics—United States:</b>                                 | <b>2014</b> | <b>2015</b> | <b>2016</b> | <b>2017</b> | <b>2018<sup>e</sup></b> |
|--|-------------|-------------|-------------|-------------|-------------------------|
| Production:  |             |             |             |             |                         |
| Primary  | W           | W           | W           | W           | W                       |
| Secondary (new and old scrap)  | 81          | 88          | 102         | 114         | 100                     |
| Imports for consumption  | 52          | 49          | 46          | 42          | 49                      |
| Exports  | 17          | 15          | 19          | 14          | 12                      |
| Consumption:   |             |             |             |             |                         |
| Reported, primary  | 64          | 64          | 69          | 65          | 70                      |
| Apparent <sup>2</sup>  | W           | W           | W           | W           | W                       |
| Price, yearend:  |             |             |             |             |                         |
| U.S. spot Western, dollars per pound, average                            | 2.15        | 2.15        | 2.15        | 2.15        | 2.15                    |
| China, free on board, dollars per metric ton, average                    | 2,325       | 1,825       | 2,390       | 2,350       | 2,530                   |
| Stocks, producer, yearend  | W           | W           | W           | W           | W                       |
| Employment, number <sup>e</sup>  | 420         | 420         | 420         | 400         | 400                     |
| Net import reliance <sup>3</sup> as a percentage of apparent consumption | <50         | <50         | <25         | <25         | <25                     |

**Recycling:** In 2018, about 30,000 tons of secondary magnesium was recovered from old scrap and 70,000 tons were recovered from new scrap. Aluminum-base alloys accounted for 64% of the secondary magnesium recovered, and magnesium-based castings, ingot, and other materials accounted for about 36%.

**Import Sources (2014–17):** Israel, 27%; Canada, 22%; United Kingdom, 10%; Mexico, 9%; and other, 32%.

| <b>Tariff:</b> | <b>Item</b>          | <b>Number</b> | <b>Normal Trade Relations</b>         |
|----------------|----------------------|---------------|---------------------------------------|
|                |                      |               | <b>12–31–18</b>                       |
|                | Unwrought metal      | 8104.11.0000  | 8.0% ad val.                          |
|                | Unwrought alloys     | 8104.19.0000  | 6.5% ad val.                          |
|                | Scrap                | 8104.20.0000  | Free.                                 |
|                | Powders and granules | 8104.30.0000  | 4.4% ad val.                          |
|                | Wrought metal        | 8104.90.0000  | 14.8¢/kg on Mg content + 3.5% ad val. |

**Depletion Allowance:** Dolomite, 14% (Domestic and foreign); magnesium chloride (from brine wells), 5% (Domestic and foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** The sole U.S. producer of primary magnesium temporarily shut down some capacity at the end of 2016 citing the shutdown of a titanium sponge plant that had been a major customer, and this capacity was not expected to restart in the foreseeable future. An explosion and fire occurred in the scrap melting area of a magnesium diecasting plant in Michigan in May. Production was temporarily shut down for several months during the year while repairs were made to the facility.

In May 2018, the U.S. Department of the Interior, in coordination with other executive branch agencies, published a list of 35 critical minerals (83 FR 23295), including magnesium metal. This list was developed to serve as an initial focus, pursuant to Executive Order 13817, “A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals” (82 FR 60835).

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In China, a new 100,000-ton-per-year plant in Qinghai Province that was completed in 2017 started producing magnesium from lake brines and was expected to ramp up to full capacity in 2019. Estimated production in China in 2018 decreased by approximately 15% compared with that in 2017, owing to shutdowns in the second half of the year ordered by regulators in an effort to decrease pollution and conserve energy. Some plants producing magnesium using the Pidgeon (silicothermic reduction) process were shut down, owing to energy cost increases and to comply with environmental regulations ordered by the Government of China and more are expected to shut down in 2019.

Producers in China dominate global magnesium metal production, but several projects were under development to increase primary magnesium metal capacity elsewhere. One company conducted laboratory testing to recover magnesium from its dolomite deposit in Nevada and was planning to conduct a feasibility study for a proposed plant. A company in Quebec, Canada, produced a limited amount of magnesium from serpentine contained in asbestos tailings at its 200-ton-per-year pilot plant and was planning to construct a 50,000-ton-per-year plant. Another company was testing its process for producing magnesium from serpentine-bearing asbestos tailings in the same region of Quebec. A company in Australia was conducting a feasibility study for a 5,000-ton-per-year plant to recover magnesium from coal fly ash.

The use of magnesium in automobile parts continued to increase as automobile manufacturers sought to decrease vehicle weight in order to comply with fuel-efficiency standards. Magnesium castings have substituted for aluminum, iron, and steel in some automobiles. The substitution of aluminum for steel in automobile sheet was expected to increase consumption of magnesium in aluminum alloy sheet. Although some magnesium sheet applications have been developed for automobiles, these were generally limited to expensive sports cars and luxury vehicles, automobiles where the higher price of magnesium is not a deterrent to its use.

### World Primary Production and Reserves:

|                       | Primary production |                   | Reserves <sup>4</sup>   |
|-----------------------|--------------------|-------------------|---|
|                       | 2017               | 2018 <sup>e</sup> |   |
| United States         | W                  | W                 | Magnesium metal is derived from seawater, natural brines, dolomite, serpentine, and other minerals. The reserves for this metal are sufficient to supply current and future requirements. |
| Brazil                | 15                 | 15                |   |
| Canada                | (5)                | (5)               |   |
| China                 | 930                | 800               |   |
| Iran                  | 3                  | 5                 |   |
| Israel                | 23                 | 25                |   |
| Kazakhstan            | 9                  | 23                |   |
| Korea, Republic of    | 10                 | 10                |   |
| Russia                | 40                 | 65                |   |
| Turkey                | 14                 | 10                |   |
| Ukraine               | 8                  | 19                |   |
| World total (rounded) | <u>61,050</u>      | <u>6970</u>       |   |

**World Resources:** Resources from which magnesium may be recovered range from large to virtually unlimited and are globally widespread. Resources of dolomite, serpentine, and magnesium-bearing evaporite minerals are enormous. Magnesium-bearing brines are estimated to constitute a resource in the billions of tons, and magnesium could be recovered from seawater along world coastlines.

**Substitutes:** Aluminum and zinc may substitute for magnesium in castings and wrought products. The relatively light weight of magnesium is an advantage over aluminum and zinc in castings and wrought products in most applications; however, its high cost is a disadvantage relative to these substitutes. For iron and steel desulfurization, calcium carbide may be used instead of magnesium. Magnesium is preferred to calcium carbide for desulfurization of iron and steel because calcium carbide produces acetylene in the presence of water.

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

<sup>1</sup>See also Magnesium Compounds.

<sup>2</sup>Defined as primary production + secondary production from old scrap + imports – exports + adjustments for industry stock changes.

<sup>3</sup>Defined as imports – exports + adjustments for industry stock changes.

<sup>4</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>5</sup>Less than ½ unit.

<sup>6</sup>Excludes U.S. production.