CESIUM

(Data in metric tons of cesium oxide unless otherwise noted)

Domestic Production and Use: In 2016, there was no domestic mine production of cesium and the United States was 100% import reliant for cesium minerals. The United States sourced the majority of its pollucite, the principal cesium mineral, from the largest known deposit in North America at Bernic Lake, Manitoba, Canada; however, that operation ceased mining at the end of 2015 and continued to produce cesium products from stocks.

Cesium minerals are used as feedstocks to produce a variety of cesium compounds and cesium metal. By gross weight, cesium formate brines used for high-pressure, high-temperature well drilling for oil and gas production and exploration are the primary applications for cesium. Cesium nitrate is used as a colorant and oxidizer in the pyrotechnic industry, in petroleum cracking, in scintillation counters, and in x-ray phosphors. Cesium chloride is used in analytical chemistry applications as a reagent, in high-temperature solders, as an intermediate in cesium metal production, in isopycnic centrifugation, as a radioisotope in nuclear medicine, as a repellent in agricultural applications, and in specialty glasses.

Cesium metal is used in the production of cesium compounds and in photoelectric cells. Cesium carbonate is used in the alkylation of organic compounds and in energy conversion devices, such as fuel cells, magneto-hydrodynamic generators, and polymer solar cells. Cesium bromide is used in infrared detectors, optics, photoelectric cells, scintillation counters, and spectrophotometers. Cesium hydroxide is used as an electrolyte in alkaline storage batteries. Cesium iodide is used in fluoroscopy equipment—Fourier Transform Infrared spectrometers—as the input phosphor of x-ray image intensifier tubes, and in scintillators.

Cesium isotopes, which are obtained as a byproduct in nuclear fission or formed from other isotopes, such as barium-131, are used in electronic, medical, and research applications. Cesium isotopes are used as an atomic resonance frequency standard in atomic clocks, playing a vital role in global positioning satellites, Internet and cellular telephone transmissions, and aircraft guidance systems. Cesium clocks monitor the cycles of microwave radiation emitted by cesium's electrons and use these cycles as a time reference. Owing to the high accuracy of the cesium atomic clock, the international definition of 1 second is based on the cesium atom. The U.S. civilian time and frequency standard is based on a cesium fountain clock at the National Institute of Standards and Technology in Boulder, CO. The U.S. military frequency standard, the United States Naval Observatory Time Scale, is based on 48 weighted atomic clocks, including 25 cesium fountain clocks.

Fission byproducts cesium-131 and cesium-137 are used primarily to treat cancer. A company in Richland, WA, produced a range of cesium-131 medical products for treatment of various cancers. Cesium-137 also is widely used in industrial gauges, in mining and geophysical instruments, and for sterilization of food, sewage, and surgical equipment. Cesium isotopes can be used in metallurgy to remove gases and other impurities, and in vacuum tubes.

Salient Statistics—United States: Consumption, import, and export data for cesium have not been available since the late 1980s. Because cesium metal is not traded in commercial quantities, a market price is unavailable. Only a few thousand kilograms of cesium are consumed in the United States every year. The United States is 100% import dependent for its cesium needs. In 2016, one company offered 1-gram ampoules of 99.8% (metal basis) cesium for $61.49 and 99.98% (metal basis) cesium for $76.41, an increase of 3.0% and 4.1%, respectively, from those in 2015. The prices that the company offered for 50 grams of 99.9% (metal basis) cesium acetate, cesium bromide, cesium carbonate, cesium chloride, and cesium nitrate were $114.74, $70.33, $99.50, $100.06, and $173.00, respectively. The price for a cesium-plasma standard solution (10,000 micrograms per milliliter) was $65.12 for 50 milliliters and $127.72 for 100 milliliters.

Recycling: Cesium formate brines are typically rented by oil and gas exploration clients. After completion of the well, the used cesium formate brine is returned and reprocessed for subsequent drilling operations. Cesium formate production from Canada was estimated to be 5,630 tons per year, including 3,890 tons of cesium from 17,300 tons of pollucite ore. The formate brines are recycled with a recovery rate of 85%, which can be retrieved for further use.

Import Sources (2012–15): Canada is the chief source of pollucite concentrate imported by the United States.

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CESIUM

Tariff: Item	Number	Normal Trade Relations 12–31–16
Alkali metals, other	2805.19.9000	5.5% ad val.
Chlorides, other	2827.39.9000	3.7% ad val.
Bromides, other	2827.59.5100	3.6% ad val.
Nitrates, other	2834.29.5100	3.5% ad val.
Carbonates, other	2836.99.5000	3.7% ad val.
Cesium-137, other	2844.40.0021	Free

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Domestic cesium occurrences will likely remain uneconomic unless market conditions change. No known human health issues are associated with naturally occurring cesium, and its use has minimal environmental impact. Radioactive isotopes of cesium have been known to cause adverse health effects.

During 2016, several projects that were primarily aimed at developing lithium resources were at various stages of development in Manitoba, Canada. The projects focused on pollucite and spodumene deposits, which primarily contain lithium, tantalum, or both, but may also contain minor quantities of cesium and rubidium.

A pollucite operation at Bernic Lake completed a development project in November 2015 after mine collapses in 2010 and 2013, but ceased mining at the site that year. The company indicated it had sufficient stocks of raw materials to continue producing its cesium products for the foreseeable future. The company also planned to continue exploring possibilities for accessing the mine's reserves, as well as alternative sources of cesium as needed.

World Mine Production and Reserves: Pollucite, mainly found in association with lithium-rich, lepidolite-bearing or petalite-bearing zoned granite pegmatites, is the principal cesium ore mineral. Cesium reserves are, therefore, estimated based on the occurrence of pollucite, which is mined as a byproduct of the lithium mineral lepidolite. Most pollucite contains 5% to 32% cesium oxide (Cs_2O). Data on cesium resources, other than those listed, are either limited or not available. The main pollucite zone at Bernic Lake in Canada contains approximately 120,000 tons of contained cesium oxide in pollucite ore, with premining average ore grades of 23.3% Cs_2O. Sites near Lake Ontario have identified cesium resources; exploration of those deposits has been ongoing since 2013. Zimbabwe and Namibia produced cesium in small quantities as a byproduct of lithium mining operations. Reserves for Canada were removed from the list because mining operations ceased in 2015.

	Reserves[1]
Namibia	30,000
Zimbabwe	60,000
Other countries	NA
World total (rounded)	90,000

World Resources: World resources of cesium have not been estimated. Cesium is associated with lithium-bearing pegmatites worldwide, and cesium resources have been identified in the United States, Canada, Namibia, and Zimbabwe. In the United States, pollucite occurs in pegmatites in Alaska, Maine, and South Dakota. Lower concentrations are also known in brines in Chile and China and in geothermal systems in Germany, India, and Tibet. China was believed to have cesium-rich deposits of pollucite, lepidolite, and geyserite, with concentrations highest in Yichun, Jiangxi, China, although no resource or production estimates were available.

Substitutes: Cesium and rubidium can be used interchangeably in many applications because they have similar physical properties and atomic radii. Cesium, however, is more electropositive than rubidium, making it a preferred material for some applications. However, rubidium is mined from similar deposits, in relatively smaller quantities, as a byproduct of cesium production in pegmatites and as a byproduct of lithium production from lepidolite (hard rock) mining and processing, making it no more readily available than cesium.

NA Not available.
[1]See Appendix C for resource and reserve definitions and information concerning data sources.