CESIUM

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

Domestic Production and Use: In 2014, there was no domestic production of cesium and the United States was 100% import reliant for cesium minerals. The principal cesium mineral, pollucite, is known to occur in pegmatites in Alaska, Maine, and South Dakota. The United States sources the majority of pollucite from the largest known North American deposit at Bernic Lake, Manitoba, Canada.

Cesium, in the form of chemical compounds, is the principal end use of cesium ore. By gross weight, formate brines for high-pressure/high-temperature oil and gas drilling 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, cesium metal production, high-temperature solders, isopycnic centrifugation, nuclear medicine, repellents, specialty glasses, and spectrometers. Cesium carbonate is used in the N-alkylation of 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 scintillators.

Cesium isotopes, which can be obtained as a fission by-product 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 a 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. One 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 can be used in metallurgy to remove gases and other impurities, and as a "getting" agent 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. In 2014, one company offered 1-gram ampoules of 99.8% (metal basis) cesium for $59.70 each and 99.98% (metal basis) cesium for $73.40, an increase of 3.9% and 4.1%, respectively, from those of 2013. The price for 50 grams of 99.8% (metals basis) cesium was $736.00, and 100 grams of 99.98% (metal basis) cesium was priced at $2,020.00, an increase of 3.8% and 3.9%, respectively, from those of 2013 for both products.

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

Import Sources (2010–13): Canada is the chief source of pollucite concentrate imported by the United States.

Tariff: Item	Number	Normal Trade Relations 12–31–14
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.

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Events, Trends, and Issues: Domestic cesium occurrences will likely remain uneconomic unless market conditions change. Cesium can be produced as a byproduct of lithium production. 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.

As reported in 2014, one underground mining operation at Bernic Lake, Manitoba, Canada, experienced a fall of ground in early 2013 following a similar event in 2010. Monitoring equipment was installed at the site that indicated good structural stability; however, the mines stability may be at risk for near-term deterioration and flooding. Development alternatives were assessed for continuity of operations. The company increased production to assure cesium ore inventory would meet customer needs in the event they would be unable to continue mining or unwilling to incur costs needed to further develop the mine. In Argentina, one company began bulk sampling and drilling to determine resource estimates for a cesium and rubidium deposit. The deposit underwent prefeasibility studies and expected reserve estimates to be complete by yearend 2014. Initial studies indicated a cesium to rubidium ratio of 8:1.

In 2014, one company in Richland, WA, announced improved results and FDA approval for using cesium-131 seeds for the treatment of gynecologic cancers, instead of gold-198, owing to its blend of high energy and 9.7-day half-life. Another company, in Austin, TX, was awarded a $1.1 million grant by the Department of Energy for the development and marketing of a Self-Contained Blood Irradiator, a replacement for radioactive isotope irradiators that contain cesium-137. A policy statement from the Nuclear Regulatory Commission encouraged the replacement of cesium-137 chloride in devices, as well as a long-term strategy for its storage and disposal, owing to the potential for use in a radiological dispersal device.

In April, the National Institute of Standards and Technology launched the NIST-F2, a new type of cesium fountain clock that utilizes a colder environment, tripling the accuracy over its predecessor, NIST-F1. The NIST-F2 became the world's most accurate time standard and will now serve as the U.S. civilian time and frequency standard. The agency utilizes over 300 atomic clocks across the world to establish the Coordinated Universal Time (UTC), the international standard of time. In September, Kazakhstan's National Security Committee reported a container of cesium, most likely originating from a medical facility, had gone missing in the western region of Kazahkstan. A vanadosilicate was developed in Seoul, South Korea, that can remove cesium-137 from contaminated coolant water, liquid nuclear waste, and contaminated water sources more effectively than conventional sorbents.

World Mine Production and Reserves: Pollucite, mainly formed 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% 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 pollucite, with pre-mining average Cs_2O grades of 23.3%. Sites near Lake Ontario have identified cesium resources; exploration of those deposits began in the last quarter of 2013. Zimbabwe and Namibia produced cesium in small quantities as a byproduct of lithium mining operations.

	Reserves[1]
Canada	120,000
Namibia	30,000
Zimbabwe	60,000
Other countries	NA
World total (rounded)	210,000

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. 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.

NA Not available.

[1]See Appendix C for resource/reserve definitions and information concerning data sources.