

LITHIUM

(Data in metric tons of lithium content unless otherwise noted)

Domestic Production and Use: The only lithium production in the United States was from a brine operation in Nevada. Two companies produced a wide range of downstream lithium compounds in the United States from domestic or imported lithium carbonate, lithium chloride, and lithium hydroxide. Domestic production was not published to avoid disclosing company proprietary data.

Although lithium markets vary by location, global end-use markets are estimated as follows: batteries, 39%; ceramics and glass, 30%; lubricating greases, 8%; continuous casting mold flux powders and polymer production, 5% each; air treatment, 3%; and other uses, 10%. Lithium consumption for batteries has increased significantly in recent years because rechargeable lithium batteries are used extensively in the growing market for portable electronic devices and increasingly are used in electric tools, electric vehicles, and grid storage applications. Lithium minerals were used directly as ore concentrates in ceramics and glass applications.

Salient Statistics—United States:	2012	2013	2014	2015	2016^e
Production	W	1,870	W	W	W
Imports for consumption	2,760	2,210	2,120	2,750	3,280
Exports	1,300	1,230	1,420	1,790	1,550
Consumption, apparent	W	1,800	W	W	W
Price, annual average, battery-grade lithium carbonate, dollars per metric ton ²	6,060	6,800	6,690	6,500	7,400
Employment, mine and mill, number	70	70	70	70	70
Net import reliance ³ as a percentage of apparent consumption	>50	>50	>50	>25	>50

Recycling: Historically, lithium recycling has been insignificant but has increased steadily owing to the growth in consumption of lithium batteries. One domestic company has recycled lithium metal and lithium-ion batteries since 1992 at its facility in British Columbia, Canada. In 2009, the U.S. Department of Energy awarded \$9.5 million to the company to construct the first U.S. recycling facility for lithium-ion vehicle batteries and, in 2015, the facility in Lancaster, OH, began operation.

Import Sources (2012–15): Chile, 57%; Argentina, 40%; China, 2%; and other, 1%.

Tariff:	Item	Number	Normal Trade Relations 12–31–16
	Other alkali metals	2805.19.9000	5.5% ad val.
	Lithium oxide and hydroxide	2825.20.0000	3.7% ad val.
	Lithium carbonate:		
	U.S.P. grade	2836.91.0010	3.7% ad val.
	Other	2836.91.0050	3.7% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: The Defense Logistics Agency Strategic Materials planned to acquire 300 kilograms of lithium cobalt oxide and 1,080 kilograms of lithium nickel cobalt aluminum oxide in FY 2016.

Stockpile Status—9–30–16⁴

Material	Inventory	Disposal Plan FY 2016	Disposals FY 2016
Lithium cobalt oxide (kilograms, gross weight)	241	—	—
Lithium nickel cobalt aluminum oxide (kilograms, gross weight)	990	—	—

Events, Trends, and Issues: Worldwide lithium production increased by an estimated 12% in 2016 in response to increased lithium demand for battery applications. Production in Argentina increased almost 60%, primarily owing to a new brine operation; the leading Argentine producer also increased production. A producer in Chile reported that its production increased by 20%. Two small Australian spodumene operations, one new and one inactive since 2013, planned to begin commercial concentrate production by yearend. Worldwide lithium production capacity was reported to be 49,400 tons in 2015; capacity utilization was estimated to be 64% in 2015 and 71% in 2016. Based on average projections by producers and industry analysts of about 14% growth worldwide, consumption of lithium in 2016 is

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projected to be about 37,800 tons, up from 33,300 tons in 2015. Despite available capacity, spot lithium carbonate prices in China increased up to 300%, briefly exceeding \$20,000 per ton, based on an acute, but likely temporary, shortage of imported spodumene from Australia. The rest of the world experienced spot price increases of approximately 40% to 60% from those of 2015, owing to lithium demand moderately exceeding supply. For large fixed contracts, Industrial Minerals reported a 14% increase in average U.S. lithium carbonate prices.

Two brine operations in Chile and a spodumene operation in Australia accounted for the majority of world lithium production. One of the producers in Chile received Government approval to increase its brine extraction from the Salar de Atacama. The two lithium producers in Chile and the leading lithium producer in Argentina each announced plans to further expand lithium hydroxide production capacity to meet increasing demand from the electric vehicle industry. The joint owners of the leading spodumene operation in Australia announced plans to increase capacity and one owner began construction of a lithium hydroxide plant in Australia. To diversify supply, Chile's two lithium producers each announced planned joint ventures with companies in Argentina.

Lithium supply security has become a top priority for technology companies in the United States and Asia. Strategic alliances and joint ventures between technology companies and exploration companies continue to be established to ensure a reliable, diversified supply of lithium for battery suppliers and vehicle manufacturers. Brine operations were under development in Argentina, Bolivia, Chile, China, and the United States; spodumene mining operations were under development in Australia, Canada, China, and Finland; a jadarite mining operation was under development in Serbia; and a lithium-clay mining operation was under development in Mexico. Additional exploration for lithium continued, with numerous claims having been leased or staked worldwide.

A leading electric car manufacturer was constructing a lithium-ion battery plant in Nevada capable of producing up to 500,000 lithium-ion vehicle batteries per year. The plant was expected to be vertically integrated, capable of producing finished battery packs directly from raw materials by 2018.

World Mine Production and Reserves: The reserves estimate for Australia has been revised based on new information from a Government source.

	Mine production		Reserves ⁵
	2015	2016 ^e	
United States	W	W	38,000
Argentina	3,600	5,700	2,000,000
Australia	14,100	14,300	1,600,000
Brazil	200	200	48,000
Chile	10,500	12,000	7,500,000
China	2,000	2,000	3,200,000
Portugal	200	200	60,000
Zimbabwe	900	900	23,000
World total (rounded)	⁶ 31,500	⁶ 35,000	14,000,000

World Resources: Owing to continuing exploration, lithium resources have increased substantially worldwide. Identified lithium resources in the United States, from continental brines, geothermal brines, hectorite, oilfield brines, and pegmatites, have been revised to 6.9 million tons. Identified lithium resources in other countries have been revised to approximately 40 million tons. Identified lithium resources in Argentina and Bolivia are approximately 9 million tons each and in major producing countries are: Australia, more than 2 million tons; Chile, more than 7.5 million tons; and China, approximately 7 million tons. Canada's lithium resources are about 2 million tons. Congo (Kinshasa), Russia, and Serbia have resources of approximately 1 million tons each. Lithium resources in Brazil and Mexico are approximately 200,000 tons each and Austria and Zimbabwe have more than 100,000 tons each.

Substitutes: Substitution for lithium compounds is possible in batteries, ceramics, greases, and manufactured glass. Examples are calcium, magnesium, mercury, and zinc as anode material in primary batteries; calcium and aluminum soaps as substitutes for stearates in greases; and sodic and potassic fluxes in ceramics and glass manufacture.

^eEstimated. W Withheld to avoid disclosing company proprietary data. — Zero.

¹Source: Rockwood Holdings, Inc., 2014, 2013 annual report: Princeton, NJ, Rockwood Holdings, Inc., p. 16.

²Source: Industrial Minerals, IM prices: Lithium carbonate, large contracts, delivered continental United States.

³Defined as imports – exports + adjustments for Government and industry stock changes.

⁴See [Appendix B](#) for definitions.

⁵See [Appendix C](#) for resource and reserve definitions and information concerning data sources.

⁶Excludes U.S. production.