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 withheld to avoid disclosing company proprietary data.

Although lithium markets vary by location, global end-use markets are estimated as follows: batteries, 46%; ceramics and glass, 27%; lubricating greases, 7%; polymer production, 5%; continuous casting mold flux powders, 4%; air treatment, 2%; and other uses, 9%. 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:	**2013**	**2014**	**2015**	**2016**	**2017[e]**
Production	[1]870	W	W	W	W
Imports for consumption	2,210	2,130	2,750	3,140	3,430
Exports	1,230	1,420	1,790	1,520	1,850
Consumption, estimated	2,000	[2]2,000	[2]2,000	[2]3,000	[2]3,000
Price, annual average, battery-grade lithium carbonate, dollars per metric ton[3]	6,800	6,690	6,500	8,650	13,900
Employment, mine and mill, number	70	70	70	70	70
Net import reliance[4] as a percentage of estimated consumption	>50	>25	>25	>50	>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 (2013–16): Chile, 49%; Argentina, 48%; China, 2%; and other, 1%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–17**
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. pharmaceutical 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 600 kilograms of lithium cobalt oxide and 2,160 kilograms of lithium nickel cobalt aluminum oxide in FY 2018.

Stockpile Status—9–30–17[5]

Material	**Inventory**	**Disposal Plan FY 2017**	**Disposals FY 2017**
Lithium cobalt oxide (kilograms, gross weight)	450	—	—
Lithium nickel cobalt aluminum oxide (kilograms, gross weight)	1,550	—	—

Events, Trends, and Issues: Worldwide lithium production increased by an estimated 13% to 43,000 tons in 2017 in response to increased lithium demand for battery applications. Consumption of lithium in 2017 was projected to be about 41,500 tons, up from 36,700 tons in 2016. Production in Australia increased by approximately 34% as two new spodumene operations ramped up production of concentrate throughout 2017. The leading lithium producers in Argentina, Australia, and Chile reported strong sales; however, heavy snowfall limited production at Argentina's new brine operation. Worldwide lithium production capacity was estimated to be 58,000 tons per year in 2016.

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LITHIUM

Spot lithium carbonate prices in China ranged from $15,000 to $24,000 per ton throughout the year owing to tight supply of imported spodumene from Australia. The rest of the world experienced more modest price increases owing to supplies available from more diversified sources of lithium. For large fixed contracts, Industrial Minerals reported an annual average U.S. lithium carbonate price of $13,900 per metric ton in 2017, a 61% increase from that of 2016.

Three spodumene operations in Australia and two brine operations each in Argentina and Chile accounted for the majority of world lithium production. Argentina's leading lithium producer expanded its lithium hydroxide production capacity by 80% in 2017 to meet increasing demand from the electric vehicle industry. The joint owners of the leading spodumene operation in Australia planned to double its spodumene concentrate production capacity to 1.34 million tons per year by mid-2019. To diversify supply, Chile's leading lithium producer announced a joint venture with a company in Australia to develop a spodumene operation. This follows a 2016 joint venture that the company in Chile established with a company in Argentina to develop a brine operation. Chile's two lithium producers each announced plans to build lithium hydroxide plants in Australia.

Lithium supply security has become a top priority for technology companies in the United States and Asia. Strategic alliances and joint ventures among technology companies and exploration companies continued 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, Austria, Canada, China, Czechia, Finland, Mali, Portugal, and Spain; a jadarite mining operation was under development in Serbia; and lithium-clay mining operations were under development in Mexico and the United States. Additional exploration for lithium continued, with numerous claims having been leased or staked worldwide.

World Mine Production and Reserves: Reserves for Australia and the United States were revised based on new information from Government and industry sources.

	Mine production		Reserves[6]
	2016	2017[e]	
United States	W	W	35,000
Argentina	5,800	5,500	2,000,000
Australia	14,000	18,700	[7]2,700,000
Brazil	200	200	48,000
Chile	14,300	14,100	7,500,000
China	2,300	3,000	3,200,000
Portugal	400	400	60,000
Zimbabwe	1,000	1,000	23,000
World total (rounded)	[8]38,000	[8]43,000	16,000,000

World Resources: Owing to continuing exploration, lithium resources have increased substantially worldwide and total more than 53 million tons. Identified lithium resources in the United States, from continental brines, geothermal brines, hectorite, oilfield brines, and pegmatites, have been revised to 6.8 million tons. Identified lithium resources in other countries have been revised to approximately 47 million tons. Identified lithium resources in Argentina are 9.8 million tons; Bolivia, 9 million tons; Chile, 8.4 million tons; China, 7 million tons; Australia, 5 million tons; Canada, 1.9 million tons; Congo (Kinshasa), Russia, and Serbia, 1 million tons each; Czechia, 840,000 tons; Zimbabwe, 500,000 tons; Spain, 400,000 tons; Mali, 200,000 tons; Brazil and Mexico, 180,000 tons each; Portugal, 100,000 tons; and Austria, 50,000 tons.

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.

[e]Estimated. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Source: Rockwood Holdings, Inc., 2014, 2013 annual report: Princeton, NJ, Rockwood Holdings, Inc., p. 16.
[2]Defined as production + imports – exports. Rounded to one significant digit to avoid disclosing company proprietary data.
[3]Source: Industrial Minerals, IM prices: Lithium carbonate, large contracts, delivered continental United States.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]See Appendix B for definitions.
[6]See Appendix C for resource and reserve definitions and information concerning data sources.
[7]For Australia, Joint Ore Reserves Committee-compliant reserves were about 1.4 million tons
[8]Excludes U.S. production.