

## LITHIUM

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

**Domestic Production and Use:** The only active lithium carbonate plant in the United States was a brine operation in Nevada. Two companies produced a large array of downstream lithium compounds in the United States from domestic or South American lithium carbonate. A U.S. recycling company produced a small quantity of lithium carbonate from solutions recovered during the recycling of lithium-ion batteries.

Although lithium markets vary by location, global end-use markets are estimated as follows: ceramics and glass, 29%; batteries, 27%; lubricating greases, 12%; continuous casting, 5%; air treatment, 4%; polymers, 3%; primary aluminum production, 2%; pharmaceuticals, 2%; and other uses, 16%. Lithium use in batteries expanded significantly in recent years because rechargeable lithium batteries were being used increasingly in portable electronic devices and electrical tools.

<b>Salient Statistics—United States:</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011<sup>e</sup></b>
Production	W	W	W	W	W
Imports for consumption	3,140	3,160	1,890	1,960	2,800
Exports	1,440	1,450	920	1,410	1,200
Consumption:					
Apparent	W	W	W	W	W
Estimated	2,400	2,300	1,300	<sup>1</sup> 1,000	<sup>1</sup> 2,000
Employment, mine and mill, number	68	68	68	68	68
Net import reliance <sup>2</sup> as a percentage of apparent consumption	>50%	>50%	>50%	>50%	>80%

**Recycling:** Recycled lithium content has been historically insignificant, but has increased steadily owing to the growth in consumption of lithium batteries. One U.S. company has recycled lithium metal and lithium-ion batteries since 1992 at its Canadian facility in British Columbia. In 2009, the U.S. Department of Energy awarded the company \$9.5 million to construct the first U.S. recycling facility for lithium-ion batteries.

**Import Sources (2007–10):** Argentina, 50%; Chile, 47%; China, 2%; and other, 1%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-11</b>
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:** None.

**Events, Trends, and Issues:** Worldwide lithium production increased in 2011. Sales volumes of two major lithium producers in Australia and Chile were reported to be up approximately 20% through the third quarter of 2011 compared with those of the same period of 2010, and lithium production in China was estimated to have increased by more than 30% from that of 2010. Argentina's lithium industry experienced weather-related complications in the second quarter of 2011. Industry analysts expected worldwide consumption of lithium in 2011 to be between 22,500 and 24,500 tons, similar to that of 2010. Several brine and mineral-based lithium producers increased their lithium prices in 2011. Many new companies continued exploring for lithium on claims worldwide. Numerous claims in Nevada, as well as in Argentina, Australia, Bolivia, and Canada, have been leased or staked.

The most recent public information available on lithium production in Nevada was a 1998 U. S. Securities and Exchange Commission Report, which indicated lithium carbonate production of 5,400 tons and lithium hydroxide production of 2,270 tons. The Nevada Department of Taxation reported the 2009 gross proceeds from lithium at \$7,475,578, which was 65% lower than that of 2008.<sup>3</sup>

Subsurface brines have become the dominant raw material for lithium carbonate production worldwide because of lower production costs compared with the mining and processing costs for hard-rock ores. Two brine operations in Chile dominate the world market, and a facility at a brine deposit in Argentina produced lithium carbonate and lithium

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chloride. Several additional brine operations were under development in Argentina, with one facility expected to begin commercial production in 2012. Brine operations in China produced lithium carbonate, lithium chloride, and lithium hydroxide. Lithium minerals were used directly as ore concentrates in ceramics and glass applications worldwide and, increasingly, as feedstock for lithium carbonate and other lithium compounds in China.

Owing to China's growing demand for high-quality spodumene by its chemical companies, Australia's leading lithium ore miner planned to double its production capacity by 2012, raising its total lithium carbonate equivalent production capacity to 110,000 tons per year. An emerging Australian lithium ore producer continued lithium concentrate production in Western Australia. The lithium concentrate was to be converted to battery-grade lithium carbonate in China to supply the Asian market. Utilizing a unique reverse osmosis process, a California company began producing high-purity lithium carbonate from geothermal brines. The reverse osmosis process eliminates the need for solar evaporation, a crucial and lengthy procedure in more common brine operations. Initial lithium carbonate production capacity was 500 tons per year.

Batteries, especially rechargeable batteries, are the uses for lithium compounds with the largest growth potential. Demand for rechargeable lithium batteries continued to gain market share from rechargeable nonlithium batteries for use in cellular telephones, cordless tools, MP3 players, and portable computers and tablets. Major automobile companies were pursuing the development of lithium batteries for electric vehicles and hybrid electric vehicles—vehicles with an internal combustion engine and a battery-powered electric motor. Most commercially available hybrid vehicles use other types of batteries, although future generations of these vehicles may use lithium. Nonrechargeable lithium batteries were used in calculators, cameras, computers, electronic games, watches, and other devices.

Lithium supply security has become a top priority for Asian technology companies. Strategic alliances and joint ventures have been, and are continuing to be, established with lithium exploration companies worldwide to ensure a reliable, diversified supply of lithium for Asia's battery suppliers and vehicle manufacturers. With lithium carbonate being one of the lowest cost components of a lithium-ion battery, the issue to be addressed was not cost difference or production efficiency but supply security attained by acquiring lithium from diversified sources.

**World Mine Production and Reserves:** The reserve estimate for Australia has been revised based on new information from Government and industry sources.

	Mine production		Reserves <sup>4</sup>
	2010	2011 <sup>e</sup>	
United States	W	W	38,000
Argentina	2,950	3,200	850,000
Australia	9,260	11,300	970,000
Brazil	160	160	64,000
Chile	10,510	12,600	7,500,000
China	3,950	5,200	3,500,000
Portugal	800	820	10,000
Zimbabwe	470	470	23,000
World total (rounded)	<sup>5</sup> 28,100	<sup>5</sup> 34,000	13,000,000

**World Resources:** The identified lithium resources total 4 million tons in the United States and approximately 30 million tons in other countries. Among the other countries, identified lithium resources for Bolivia and Chile total 9 million tons and in excess of 7.5 million tons, respectively. Identified lithium resources for China, Argentina, and Australia are 5.4 million tons, 2.6 million tons, and 1.8 million tons, respectively; while Brazil, Congo (Kinshasa), and Serbia contain approximately 1 million tons each. Identified lithium resources for Canada total 360,000 tons.

**Substitutes:** Substitution for lithium compounds is possible in batteries, ceramics, greases, and manufactured glass. Examples are calcium and aluminum soaps as substitutes for stearates in greases; calcium, magnesium, mercury, and zinc as anode material in primary batteries; and sodic and potassic fluxes in ceramics and glass manufacture. Lithium carbonate is not considered to be an essential ingredient in aluminum potlines. Substitutes for aluminum-lithium alloys in structural materials are composite materials consisting of boron, glass, or polymer fibers in resins.

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

<sup>1</sup>Rounded to 1 significant figure to avoid disclosing company proprietary data.

<sup>2</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>3</sup>Davis, David, 2010, Industrial minerals *in* The Nevada mineral industry 2009: Reno, NV, Nevada Bureau of Mines and Geology, p. 121–122.

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

<sup>5</sup>Excludes U.S. production.