

Lithium Market Trends

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Abstract: *It's no secret the world faces shortages in many commodities. The world's diminishing supply of everything from cocoa to coffee, lithium to lumber, phosphate to plutonium, silver to sugar, is of great concern. There's a reason Goldman Sachs is calling lithium "the new gasoline" and The Economist says it's "the world's hottest commodity". Just in the last six months, as evidenced by the Global X Lithium ETF (NYSE: LIT), it's up a bit more than 40%. It's outperforming the S&P more than twice over. And the world will need more lithium in addition to what they can produce. In the next 10 years or so, the world will need some three to five times more lithium than was produced in 2015. The battle on the supply side is huge and it has already sent lithium prices through the roof.*

Key words: *lithium reserves, lithium production, lithium consumption, lithium price trends*

1. Introduction

Searching in Wikipedia on Lithium, we find that it is a soft, silver-white metal belonging to the alkali metal group of chemical elements. Under standard conditions, it is the lightest metal and the least dense solid element. Like all alkali metals, lithium is highly reactive and flammable. For this reason, it is typically stored in mineral oil. Because of its high reactivity, lithium never occurs freely in nature, and instead, appears only in compounds, which are usually ionic. Lithium occurs in a number of pegmatitic minerals, but due to its solubility as an ion, is present in ocean water and is commonly obtained from brines and clays. On a commercial scale, lithium is isolated electrolytically from a mixture of lithium chloride and potassium chloride. Lithium and its compounds have several industrial applications, including heat-resistant glass and ceramics, lithium grease lubricants, flux additives for iron, steel and aluminium production, lithium batteries, and lithium-ion batteries. These uses consume more than three quarters of lithium production.

2. Lithium reserves

Worldwide identified reserves in 2008 were estimated by the US Geological Survey to be 13 million tonnes, though an accurate estimate of world lithium reserves is difficult. Deposits are found in South America throughout the Andes mountain chain. Chile is the leading producer, followed by Argentina. Both countries recover lithium from brine pools. In the United States, lithium is recovered from brine pools in Nevada. However, half the world's known reserves are located in Bolivia along the central eastern slope of the Andes (Bolivia's Uyuni Desert has 5.4 million tonnes of lithium) A newly discovered deposit in Wyoming's Rock Springs Uplift is estimated to contain 228,000 tons. Additional deposits in the same formation were estimated to be as much as 18 million tons.

However, according to a 2011 study conducted at Lawrence Berkeley National Laboratory and the University of California, Berkeley, the currently estimated reserve base of lithium should not be a limiting factor for large-scale battery production for electric vehicles because an estimated 1 billion 40kWh Li-based batteries could be built with current reserves(about 10 kg of lithium per car). Another 2011 study by researchers from the University of Michigan and Ford Motor Company found sufficient resources to support

global demand until 2100, including the lithium required for the potential widespread transportation use. The study estimated global reserves at 39 million tons, and total demand for lithium during the 90-year period analyzed at 12–20 million tons, depending on the scenarios regarding economic growth and recycling rates.

3. Lithium production

Lithium production has greatly increased since the end of World War II. The metal is separated from other elements in igneous minerals. Lithium salts are extracted from water in mineral springs, brine pools, and brine deposits. The metal is produced through electrolysis from a mixture of fused 55% chloride and 45% potassium chloride at about 450 °C.

This is a **list of countries by lithium mine production** in 2014.

Rank	Country/Region	lithium mine production (tonnes)
	World	36,000
1	 Australia	13,000
2	 Chile	12,900
3	 China	5,000
4	 Argentina	2,900
5	 Zimbabwe	1,000
6	 Portugal	570
7	 Brazil	400

World production of lithium was in a sharp increase in the last two decades.



As for **2016**, Australia will supply 64,000 tons of lithium, ahead of Chile (62,000 tons) and Argentina (30,000 tons).

The biggest lithium mine is currently the Greenbushes lithium mine in southwest Australia. It's owned by Talison Lithium, which itself is 51% owned by China's Sichuan Tianqi Lithium Industries. U.S.-based Albemarle holds the rest.

Greenbushes is the world's largest single lithium reserve with roughly 4.3 million tonnes of lithium carbonate equivalent.

Australia may be the world's biggest lithium producer, but it's actually not home to the world's biggest reserves. That would be Chile. What makes Australia tops in the game, though, is that it's got a robust mining industry and close proximity to the Asian market.

One of the big problems with lithium is that its production is highly concentrated. Some 86% of production comes from just four large companies:

- Albemarle (NYSE: ALB)
- Chemical & Mining Co. of Chile (NYSE: SQM)
- FMC Corp (NYSE: FMC)

- Talison Lithium (a JV by Chengdu Tianqi Industry Group and Albemarle)

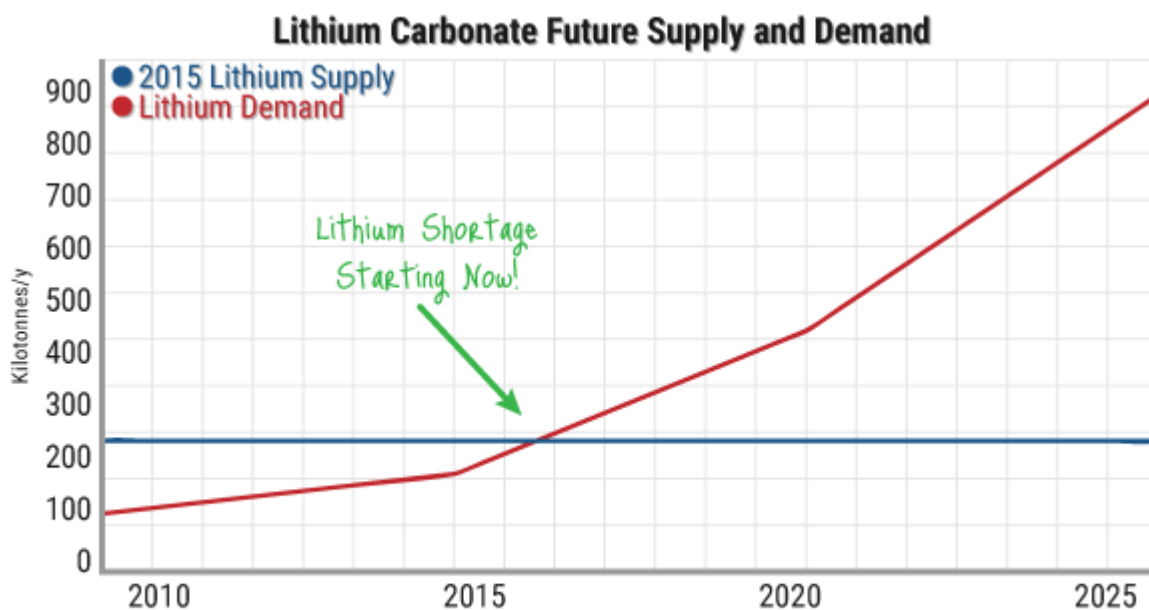
The lithium market is currently tiny in relation to other commodity markets. Annual sales of lithium in its various forms — pure lithium, carbonates, hydroxides, concentrates, etc. — total around \$1 billion. As of 2015 most of the world's lithium production is in South America, where lithium-containing brine is extracted from underground pools and concentrated by solar evaporation. The standard extraction technique is to evaporate water from brine. Lithium is present in seawater, but commercially viable methods of extraction have yet to be developed.

One potential source of lithium is the leachates of geothermal wells, which are carried to the surface. The lithium is separated by simple filtration. The process and environmental costs are primarily those of the already-operating well; net environmental impacts may thus be positive.

4. Lithium consumption

Global consumption may jump to 300,000 metric tons a year by 2020 from about 150,000 tons in 2012, to match the demand for lithium batteries that has been growing at about 25 percent a year, outpacing the 4 percent to 5 percent overall gain in lithium production.

First and foremost is that not enough lithium is being produced. In the next 10 years or so, the world will need some three to five times more lithium than was produced in 2015.



Source: Angel Publishing

The reasons for this are straightforward: the world is using more and bigger things powered by lithium batteries.

There were 1.4 billion smartphones sold last year. 194 million laptops. 320 million tablets. And lithium powers them all.

Electric car sales jumped 42% worldwide in the first quarter of 2016, hitting new highs in each of the first four months of the year. Tesla's recent presales of over 200,000 cars for its Model 3 alone would consume half the world's annual lithium production.

Tesla's biggest rival will likely be Build Your Dreams (BYD), the Chinese automaker backed by Warren Buffet. Already, BYD is building electric buses on American soil and has global gigafactory ambitions. By the end of the year, according to *Reuters*, BYD should have 10 GWh of battery production capacity, which it expects to increase to 34 GWh by 2020 with a new factory in Brazil — about the same capacity as Tesla's. China has been a chief driver in lithium demand. The country aims to have 5 million electric vehicles on its roads by 2020. Sales of “new energy” vehicles there nearly tripled last year. Meanwhile, major electronics manufacturers in Korea and Japan require lithium as well.

From 2015 to 2024, the market to supply lithium ion batteries for light vehicles may total \$221 billion, according to Navigant Consulting Inc.

By 2040, 35% of light vehicles sold will be electric, generating a battery market worth a projected \$250 billion, according to *Bloomberg*.

5. Lithium uses

Estimates of global lithium uses in 2011 are as follows:

- Ceramics and glass (29%)
- Batteries (27%)
- Lubricating greases (12%)
- Continuous casting (5%)
- Air treatment (4%)
- Polymers (3%)
- Primary aluminium production (2%)
- Pharmaceuticals (2%)
- Other (16%)

1. Ceramics and glass. Lithium oxide is widely used as a flux for processing silica, reducing the melting point and viscosity of the material and leading to glazes with improved physical properties including low coefficients of thermal expansion. Worldwide, this is the single largest use for lithium compounds.

2. Electrical and electronics. Late in the 20th century, lithium became an important component of battery electrolytes and electrodes, because of its high electrode potential. Because of its low atomic mass, it has a high charge- and power-to-weight ratio. A typical lithium-ion battery can generate approximately 3 volts per cell, compared with 2.1 volts for lead-acid or 1.5 volts for zinc-carbon cells. Lithium-ion batteries, which are rechargeable and have a high energy density, should not be confused with lithium batteries, which are disposable (primary) batteries with lithium or its compounds as the anode. Other rechargeable batteries that use lithium include the lithium-ion polymer battery, lithium iron phosphate battery, and the nanowire battery.

3. Lubricating greases. The third most common use of lithium is in greases. Lithium hydroxide is a strong base and, when heated with a fat, produces a soap made of lithium stearate. Lithium soap has the ability to thicken oils, and it is used to manufacture all-purpose, high-temperature lubricating greases.

4. Metallurgy. Lithium (e.g. as lithium carbonate) is used as an additive to continuous casting mould flux slags where it increases fluidity. Alloys of the metal with aluminium, cadmium, copper and manganese are used to make high-performance aircraft .

5. Silicon nano-welding. Lithium has been found effective in assisting the perfection of silicon nano-welds in electronic components for electric batteries and other devices.

6. Other chemical and industrial uses

Pyrotechnics

Lithium compounds are used as pyrotechnic colorants and oxidizers in red fireworks and flares.

Air purification

Lithium chloride and lithium bromide are hygroscopic and are used as desiccants for gas streams.^[13] Lithium hydroxide and lithium peroxide are the salts most used in confined areas, such as aboard spacecraft and submarines, for carbon dioxide removal and air purification.

Optics

Lithium fluoride, artificially grown as crystal, is clear and transparent and often used in specialist optics .It has one of the lowest refractive indexes and the farthest transmission range in the deep UV of most common materials. Lithium niobate is used extensively in telecommunication products such as mobile phones and optical modulators, for such components as resonant crystals. Lithium applications are used in more than 60% of mobile phones.

Organic and polymer chemistry

Organolithium compounds are widely used in the production of polymer and fine-chemicals.

Military applications

Metallic lithium and its complex hydrides, are used as high-energy additives to rocket propellants. Lithium aluminium hydride can also be used by itself as a solid fuel. Lithium hydride containing lithium-6 is used in thermonuclear weapons, where it encases the core of the bomb.

Nuclear

Lithium-6 is valued as a source material for tritium production and as a neutron absorber in nuclear fusion. Natural lithium contains about 7.5% lithium-6 from which large amounts of lithium-6 have been produced for use in nuclear weapons. Lithium-7 gained interest for use in nuclear reactor coolants,

Medicine

Lithium is useful in the treatment of bipolar disorder. Lithium salts may also be helpful for related diagnoses, such as schizoaffective disorder and cyclic major depression.

6. Recent trends in lithium market

The lithium boom caught a lot of major analysts by surprise. Lithium carbonate has surged 33% in the past year from \$6,000 per ton to \$8,000 a ton. In some cases, it's even fetched as much as \$25,000 on the spot market.

Now, that's not to say that lithium prices will shoot ever higher. There will eventually be some form of correction. But, ultimately, the trend in lithium prices leads higher over the next few years indeed, but more-so over the next few decades

Prices are up 43% so far this year. Benchmark "battery grade" lithium carbonate reached \$8,500 per metric ton in June 2016, and analysts expect prices to reach \$10,000 before the year ends. Compare that to just nine months ago when it was selling for \$5,000 to \$6,000 per ton.

Today, China is expanding at a fast pace its lithium supply chain. China's Tianqi Lithium Industries said it would build a \$306 million lithium-hydroxide plant in Australia. The plant will take ore from the Greenbushes mine, one of the world's largest lithium producers, and produce 24,000 tonnes a year of lithium hydroxide. That will boost Tianqi's processing capacity by more than 50%. This way it can keep more lithium in its own supply chain instead of exporting it to the rest of the world, which also needs increasing amounts of lithium for their electric cars, smartphones, and power tools.

Greenbushes accounted for more than 35% of global lithium supply last year, and it will have to be expanded to feed Tianqi's new Australian plant. Tianqi's partner in the Greenbushes project is Albermarle, which also runs the only lithium-producing brine operation in North America — in Nevada's Clayton Valley. The batteries will be used in electric cars as well as home energy storage. Indeed, electric car sales, the primary catalyst behind lithium demand, have torched analysts' expectations this year.

Electric car sales jumped 42% worldwide in the first quarter of 2016, hitting new highs in each of the first four months of the year. And that trend is on pace to continue throughout the year. A total of 91,300 plug-in electric vehicles were sold in Europe through the first six months of 2016, making for a 21% year-on-year increase. And U.S. plug-in hybrid car sales were up 45% this year through August.

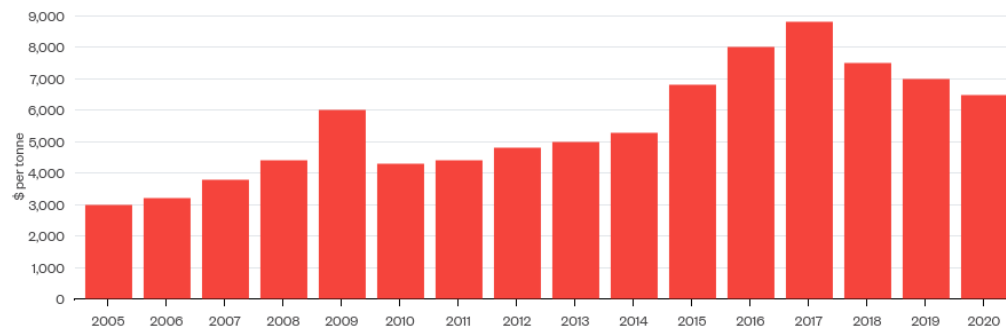
Furthermore, sales of home energy storage batteries, another major source of lithium demand, are soaring as well. This is another trend that's poised to continue. Tesla, is expected sell 168.5 megawatt-hours of energy storage systems to the nation's leading residential solar system installer, SolarCity, this year. That's six times what Tesla sold to SolarCity last year and 60% larger than the entire 2015 U.S. market. Tesla expects revenues from SolarCity to increase from \$8 million so far to \$44 million this year.

Benchmark Mineral Intelligence projects lithium carbonate prices to peak near-term in 2017 at almost \$9,000 a tonne before falling back a bit as new supply enters the market. It adds, however, that this may not prove enough, as new sources of demand such as Tesla's gigafactory in Nevada open up.

Prices have doubled since 2005, and are expected to remain elevated for the next several years.

Charged Up

The price of lithium carbonate has more than doubled since 2005



Source: Benchmark Mineral Intelligence

Note: Data for 2016 through 2020 are forecasts

Chinese government policies have sparked a boom in the sales of all electric cars and therefore in the use of lithium batteries. This has also been a driving force behind the rampant rise in lithium prices and lithium stocks. Last year, China surpassed the United States as the largest market for electric vehicles — the result of spending US\$2.3 billion on subsidies since 2009. By 2025, China wants to be selling more than three million electric cars annually. And it may issue compulsory quotas to do it.

According to a draft document from China's National Development and Reform Commission, the country considers electric vehicles a "strategic industry" and a new proposed measure would require automakers to produce or import electric vehicles relative to the number of traditional vehicles they sell. To support this growth, China needs as much lithium as it can get. And that's one of the reasons lithium prices have surged in recent months, from \$5,000 per tonne last year to as high as \$24,000 per tonne in China this year.

Recently *USA Today* reported that a lithium supply shortage is a very real possibility. It noted: We've gone electric, and there's no going back at this point. Lithium is our new fuel, but like fossil fuels, the reserves we're currently tapping into are finite — and that's what investors can take to the bank.

7. Conclusions

Just like Tesla (see Elon Musk), BYD (see Warren Buffet) will also need the world's entire lithium supply, every single year from now. And we talk just about the demand for the new battery-powered cars. So just like Musk, the "world's greatest investor" needs to dominate the supply of this „fuel", meaning that the two billionaires are at war for the world's tiny lithium supply. They're signing deals and buying mines. And in the process they've sparked a frenzy for this fuel including Google, Apple, Samsung, Panasonic, Virgin Airlines mogul Richard Branson and Chinese billionaire Jia Yueting. Toyota, GM, Nissan, and just about every big automaker have joined the race. Big Oil giant Total entered the market with a \$1.1 billion buyout of a lithium company. The US Department of Defence also depends on this fuel and it has the "first dibs" on supply. The battle is huge and it has already sent lithium prices through the roof.

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