

The Lithium Story

What is Lithium?

Lithium / lith-i-um / noun – a light, soft, silver-white metallic chemical element.

What is it used for?

When Henry Ford took to the streets with his Ford T he produced 15 million units between 1908 and 1927 that put the world in motion, literally. Since then, oil has had its place in the new world, but recently that has been starting to change and the pace of that change is ever increasing. Many countries have committed to the ending of the sales and registrations of ICEs (Internal Combustion Engine). Targets between 2030 and 2040, if reached, would completely eradicate ICE sales and have them replaced by EVs.

For the foreseeable future, lithium-ion will be the leading technology in the electric vehicle (EV) industry. With the surging fuel prices across the world and increasing pollution levels in the environment, many countries across the globe have started investing in lithium-ion technology which is used as a substitute for conventional fuel vehicles in the market. With lesser manufacturing costs and high-performance delivery, lithium batteries are considered to be the best choice in modern electric vehicles. With growing applications of lithium batteries in aerospace and military operations, the market is considered to grow at least until 2030.

According to USGS data in 2021, the uses of Lithium today can be broken down as follows,

Batteries	74	%
Ceramics and glass	14	%
Lubricating greases	3	%
Continuous Casting	2	%
Air Treatment	1	%
Other	6	%

Lithium has become the “new oil” and everyone is scrambling to take part in this new greener storage of energy. With the reservations around EVs, namely mileage, reliability and cost being answered in quick succession the consumer has gradually come to the realization that EVs are a sustainable choice. This has led to the demand driven situation we find ourselves in today. Lead times on EVs have gone from 3 weeks to 8–12 months and this will only get worse as our appetite for Lithium ion-based storage from everything from cars to laptops increase.

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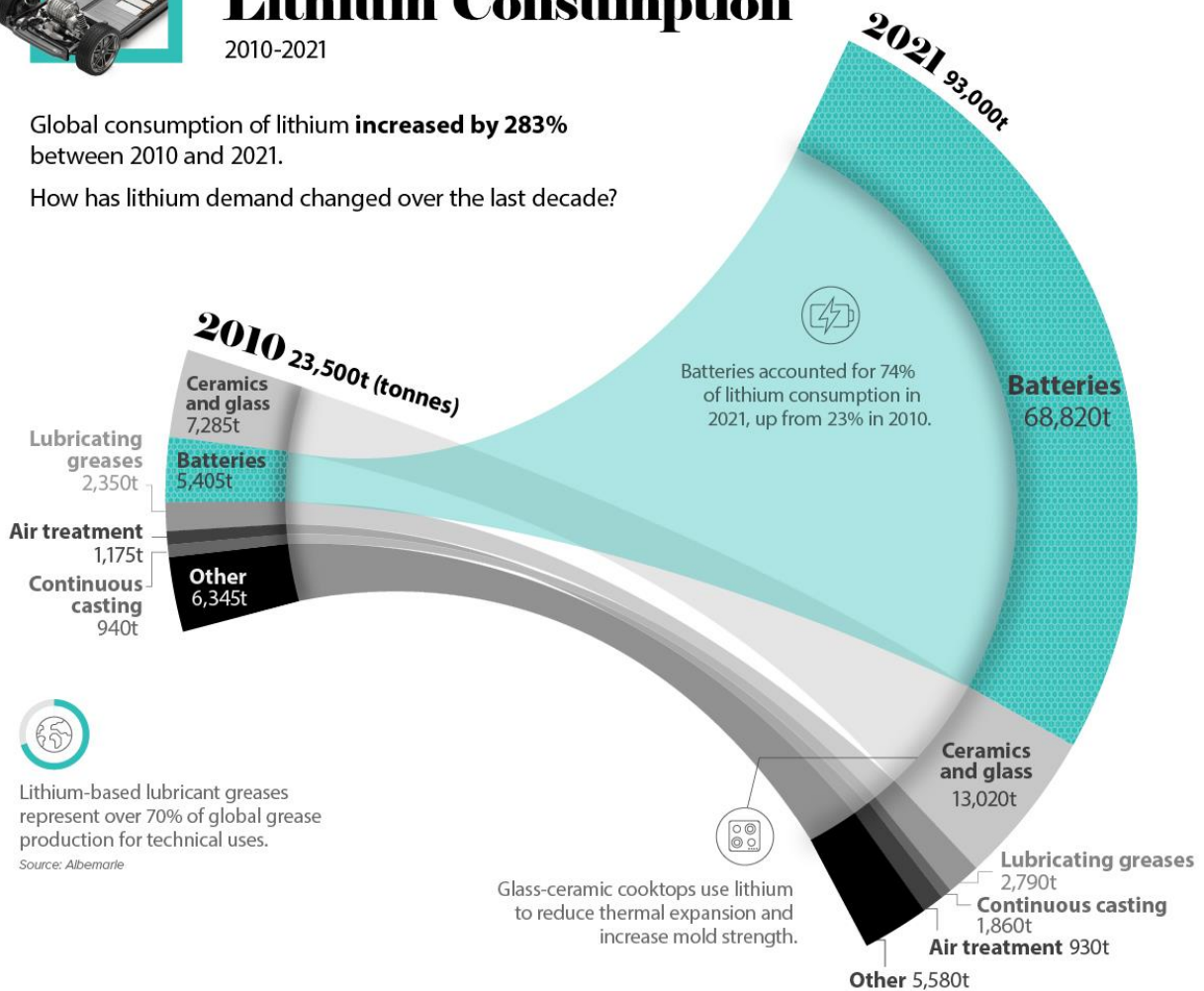


The Growth of Lithium Consumption

2010-2021

Global consumption of lithium **increased by 283%** between 2010 and 2021.

How has lithium demand changed over the last decade?



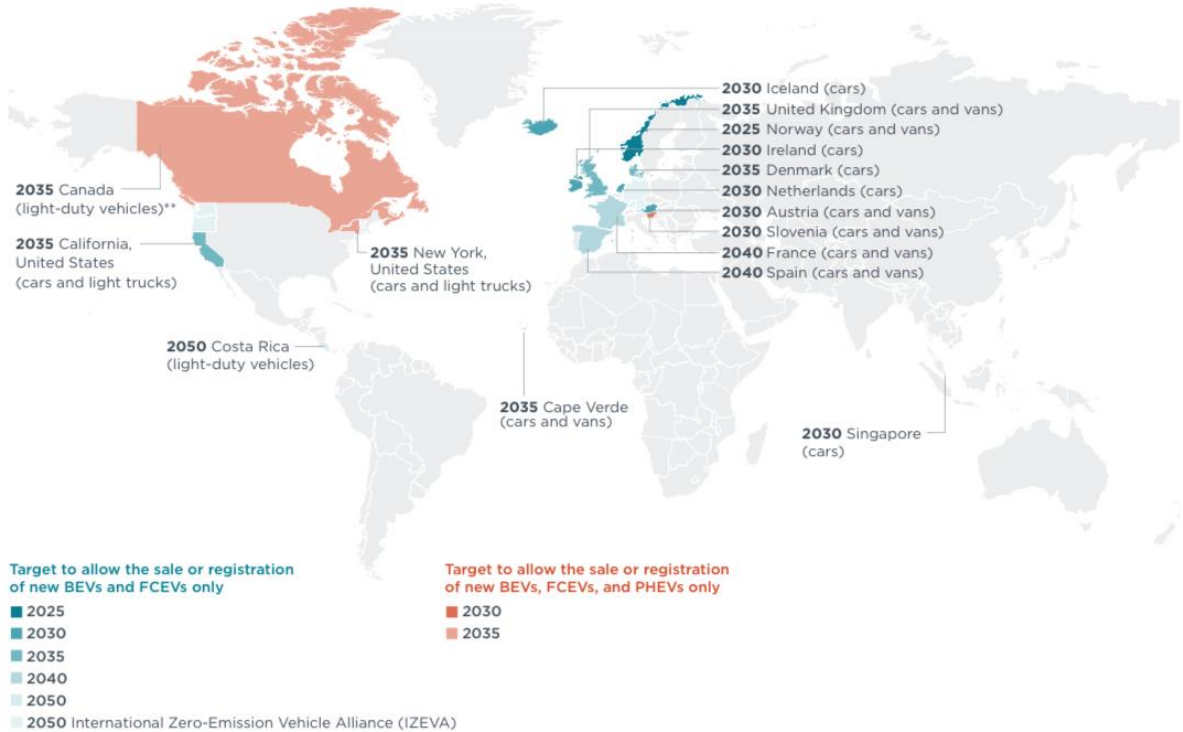
Source: USGS Mineral Commodity Summaries (2022), Minerals Yearbook (2010)

According to Grand View Research, the breakdown of Lithium use in batteries today is as follows,

Electric cars	15	%
Consumer electricals	27	%
Energy storage	23	%
Industrial	35	%

With the inevitable move towards mainstream EVs, the above 15% will rise significantly, as will the 74% attributed to batteries in the first set of figures. We already see car makers scrambling to obtain Lithium units for their future production, Elon Musk even suggesting that Tesla will have to move into Lithium mining to secure feed.

Governments with official targets to 100% phase out sales or registrations of new internal combustion engine light-duty vehicles (passenger cars and vans/light trucks) by a certain date* (Status: Through September 2021)



* Includes countries, states, and provinces that have set targets to only allow the sale or registration of new battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). Countries such as Japan with pledges that include hybrid electric vehicles (HEVs) and mild hybrid electric vehicles (MHEVs) are excluded as these vehicles are non plug-in hybrids.
 ** The Canadian province of British Columbia has set its 2040 target into binding regulation; the Canadian province of Québec has also set a target for 2035.

Where is Lithium found?

The predominantly hard rock mining in Australia accounts for over half of today's global Lithium production. However, with only 5.7 million tons of reserves, reliance on Australia is about to diminish.

Lithium is typically found either in Hard Rock and as such is mined to produce first a spodumene and latterly Lithium Hydroxide, or in Brine, using numerous chemicals and vast quantities of water to extract a Lithium Carbonate through a lengthy process of evaporation.

Chile's production is derived from the Brine variant. When looking at global reserves of Lithium, the Brine process takes on more significance. This trend is even more pronounced when looking at identified resources, where over 70% of these resources are located in the Lithium Triangle of Chile, Bolivia and Argentina (all Brine processes). We will address the significance of this trend later in the document.

Global Lithium production

Country	2020	%	2021	%
Australia	39,700	48.1	55,000	52.5
Chile	21,500	26.0	26,000	24.8
China	13,300	16.1	14,000	13.4
Argentina	5,900	7.1	6,200	5.9
Brazil	1,420	1.7	1,500	1.4
Zimbabwe	417	0.5	1,200	1.1
Portugal	348	0.4	900	0.9
	<u>82,585</u>		<u>104,800</u>	

Source USGS, 2022

figures in contained Lithium

Are there enough Lithium reserves in the world?

Is there enough Lithium in our earth's crust to cover our current and future needs as we go into this green revolution? The simple answer is yes, but does that mean we can get the Lithium in the form required at the right time, to the consumers that need it?

Global Lithium production and reserves

Country	2020	%	2021	%	Reserves	%
Australia	39,700	48.1	55,000	52.5	5,700,000	25.4
Chile	21,500	26.0	26,000	24.8	9,200,000	41.0
China	13,300	16.1	14,000	13.4	1,500,000	6.7
Argentina	5,900	7.1	6,200	5.9	2,200,000	9.8
Brazil	1,420	1.7	1,500	1.4	95,000	0.4
Zimbabwe	417	0.5	1,200	1.1	220,000	1.0
Portugal	348	0.4	900	0.9	60,000	0.3
United States					750,000	3.3
Other countries					2,700,000	12.0
	<u>82,585</u>		<u>104,800</u>		<u>22,425,000</u>	

Source USGS, 2022

figures in contained Lithium

At the United Nations Climate Change Conference, UK 2021 – COP26, the transition to zero emission vehicles was championed and what this brought to the forefront was that the OEM and car manufacturers would need to adapt, finance and collaborate to reach these goals. This set the tone for the future demand forecasts we hear about today in the lithium space. If 2040 is to become a reality, we would require a 10-to-13 fold increase in lithium production.

Global Lithium identified resources

Country	Resource	%
Bolivia	21,000,000	29.7
Argentina	19,000,000	26.8
Chile	9,800,000	13.8
Australia	7,300,000	10.3
China	5,100,000	7.2
Democratic Republic of Congo	3,000,000	4.2
Canada	2,900,000	4.1
Germany	2,700,000	3.8
Other countries	7,660	0.0
	70,807,660	

Source USGS, 2022

figures in contained Lithium

It is somewhat ironic, with the environmental push towards EVs moving ahead with great momentum, that the majority of Lithium will be produced to supply this huge demand, in the form of Lithium Carbonate, through the Brine process. At what environmental cost will these projects come into fruition, given the vast amounts of chemicals required and enormous water resources needed? Clearly care needs to be taken and it is estimated that 90% of water used is re-cycled back into the environment. One has to believe that environmental considerations will be front and foremost in producers minds, but will legislation slow the "resource to production" timeline further?

What is the difference between Lithium Carbonate and Lithium Hydroxide and why does it matter?

Lithium hydroxide is a lithium-based compound with a crucial distinctive property compared to lithium carbonate: it decomposes at a lower temperature, allowing the process of producing battery cathodes to be more sustainable and the final product to be long lasting.

For this reason, lithium hydroxide is preferred in the battery manufacturing industries, especially in EV (electric vehicles) production. It increases the performance of the battery, allowing EVs to have a higher usability range before needing a recharge.

Will reserves and identified resources be produced in time to meet increased demand?

Will supply meet demand in time? Certainly, if we talk about 2040, there is time to turn identified resources into proven reserves and move these projects into production. However, the shortfall in the coming years is clear and sizeable.

Lithium-ion Batteries represent 74% (this number is forecast to reach 90% in 2030) of the consumption for lithium. Demand for EVs, with global sales of 3millions in 2020 to 4,69millions in 2021, is projected to reach 15 million by 2030. Also, with an average of 38Kg of lithium hydroxide for each EV battery (4'690'000*38Kg) 0,56% hydroxide = 99'803Mt1 for 2021 consumption only. With a production representing 103Mt for 2021. And for 2030 (15'000'000*38Kg*0,56), we will need = 319'000Mt to satisfy only the need for EV. There will also be plenty of other utilization of Lithium for energy storage in the near future.

Figure 11: 2030 market balance projections

	Deficit Emerges	Size of Deficit in 2030e	Deficit as a % of Market
Cobalt	2023	170kt	42%
Copper	2024	10.9Mt	31%
Lithium	2024	2.1Mt	50%
Natural Graphite	2024	3.7Mt	37%
Nickel	2021	2.2Mt	37%
Rare Earths	2022	48kt	47%

Source: UBSe.

Conclusion - higher prices are inevitable

Many articles have been written about the shortage of Lithium. The consensus of opinion is not “if” it will happen, but “when”. The crucial shortage appears to be as early as 2025 and whether this shortage lasts decades or more, relies heavily on the conversion of Lithium assets into producing assets. The lead time for bringing these projects on is the main problem.

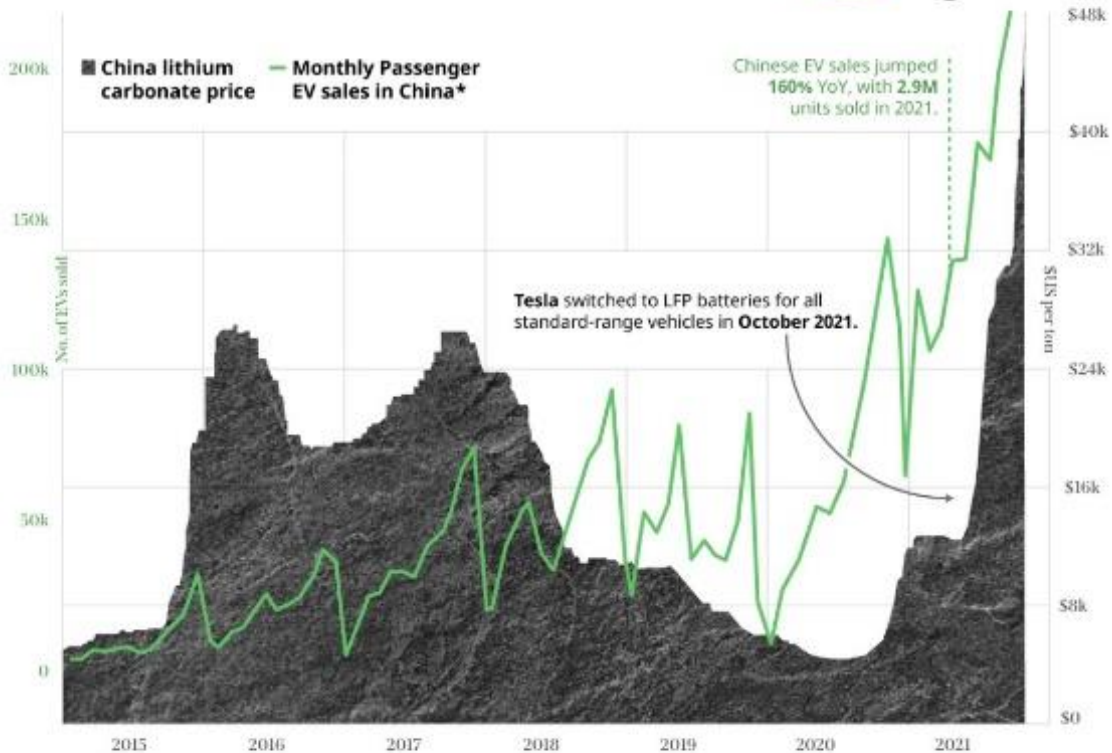
Car makers are obviously seeing the “car crash” (please excuse the pun) that is just around the corner. Almost every car maker is or intends to produce EVs and their very livelihoods depend on it. As the impending shortage becomes more and more apparent, companies are realizing that it is not simply a question of whether they will have to pay more for the Lithium to produce their cars, but will the Lithium be available at all. Stockpiling is already taking place and expect to see more from the more pro-active in the industry. However, such stockpiling also has a significant upwards pressure on prices.

Therefore, three distinct factors will contribute to Lithium price rises in future (i) the fundamentals, there is enough Lithium in the ground, but not enough will be produced in time to meet demand (ii) Stockpiling for fear of EV waiting lists becoming catastrophic and (iii) investor sentiment / speculative investors.

It is not our job to predict future Lithium prices, however, expect to see more graphs like the one below in years to come.

The Explosion in LITHIUM PRICES

Prices for lithium carbonate, a key ingredient in lithium iron phosphate (LFP) batteries for electric vehicles, rallied to record-highs on booming EV demand in China.



*EV sales as of November 30, 2021.
Currency converted from yuan to USD via xe.com, as of Jan 17, 2022.

Source: Asian Metal, China Automotive Information Net via Bloomberg