Public consultation document

Determining the Price of Minerals: A transfer pricing framework for Lithium

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IGF INTERGOVERNMENTAL FORUM on Mining, Minerals, Metals and Sustainable Development

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Determining the Price of Minerals

A transfer pricing framework for Lithium

Draft for consultation

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Authors

Jaqueline Taquiri, Policy Advisor, Tax and Extractive Industries at IGF
Thomas Lassourd, Senior Policy Advisor, Tax and Extractive Industries at IGF
Andrew Viola, Senior Advisor, Transfer Pricing and Extractive Lead at the OECD

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OECD: www.oecd.org/tax/beps/

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Introduction

About This Schedule

This mineral pricing schedule complements the practice note *Determining the Price of Minerals: A Transfer Pricing Framework*. The practice note provides a framework to identify the primary economic factors that can influence the pricing of minerals ("mineral pricing framework") using transfer pricing principles. This schedule shows how the framework can be applied to lithium brines and lithium minerals.

Framework: Using the Comparable Uncontrolled Price Method to Determine the Price of Minerals Sold

There are three primary comparability or economically relevant factors to consider that are particularly relevant when applying the comparable uncontrolled price (CUP) method to scenarios involving related-party mineral sales. These are:

- the characteristics of the product, such as the physical features and quality of the commodity;
- the economic circumstances that existed at the time the sales agreement was entered into—that is, the period of the arrangement; and
- contractual terms, such as quantity transacted, transportation terms, payment terms, insurance, quotation periods, foreign exchange, and treatment and refining charges.

Importantly, this framework is premised on the following overarching conditions:

1. The associated mining enterprise (i.e., the seller) is treated as a mining enterprise that is part of a larger multinational mining group.
2. Being part of the multinational group, the mining enterprise would have access to knowledge and intelligence of the commodity market conditions from its sister companies or its parent entity. This market knowledge and intelligence should include an awareness that the producing mine is one of a finite number of production entities in the world, and it produces a finite resource that is the primary source of value creation.
3. It is on this basis that the associated mining enterprise, operating wholly independently, would assess all of the options realistically available to it with the full benefit of market intelligence and knowledge that the wider multinational enterprise group has access to and sell at the highest possible price, taking into account its commercial objectives.

Application to Lithium

Lithium and Market Conditions

The lightest and most reactive of the alkali metals, lithium is a delicate silver-white metal. This element is found in trace amounts in almost all brines, minerals, clays, and seawater.[1]

Lithium is used predominantly for developing lithium-ion batteries. Given its characteristics—high specific heat, high thermic capacity, low specific density, high voltage, and electric conductivity, which enable lithium to store and transmit energy—lithium is well suited to power electric and hybrid vehicles, portable electronic devices, and renewable energy grid storage solutions. For electric vehicles, lithium is present in all cathode chemistries, representing between 75% and 85% of the cathode raw material cost to date.

Lithium has industrial applications, such as ceramics and glass, lubricants and grease, metallurgy, continuous casting mould flux powders, air treatment, and medical. According to the latest United States Geological Survey (USGS), global end-use markets for lithium were estimated as follows: batteries, 80%; ceramics and glass, 7%; lubricating greases, 4%; continuous casting mould flux powders, 2%; air treatment, 1%; medical, 1%; and other uses, 5%.[2]

Lithium is traded either in chemical form or as a concentrate. The two dominant chemical forms of lithium on the global market are lithium carbonate and lithium hydroxide. Lithium-bearing minerals, such as spodumene, petalite and lepidolite, can be sold as concentrates.

Physical Characteristics of Lithium Deposits

At the time of writing, lithium can be extracted commercially from two types of deposits: brines and minerals (rocks).[3] These types of deposits have different characteristics and geographical locations. As a result, the countries with the largest lithium resources are either countries with a majority of brine deposits, such as Bolivia, Argentina, United States, and Chile or those with a majority of mineral deposits, such as Australia, China, or the Democratic Republic of the Congo (DRC). The following table provides an overview of the countries that host the largest lithium resources worldwide. Because not all of the countries on the list have developed their resources through exploration and development, the global list of lithium reserves, the part of the resources that are commercially recoverable, in Table 2, looks somewhat different from this table.

[1] See: Lithium - International Lithium Association
[2] Available at USGS, 2023. *Lithium*. Lithium (usgs.gov)
[3] Lithium production from clays will not be commercially significant at least until 2028.

Table 1. Lithium resources by country (tonnes of contained lithium)[4]

Country	2022
Bolivia	21,000,000
Argentina	20,000,000
United States	12,000,000
Chile	11,000,000
Australia	7,900,000
China	6,800,000
Germany	3,200,000
DRC (Kinshasa)	3,000,000
Canada	2,900,000
Mexico	1,700,000
Czechia	1,300,000
Serbia	1,200,000
Russia	1,000,000
Peru	880,000
Mali	840,000
Brazil	730,000
Zimbabwe	690,000
Spain	320,000
Portugal	270,000
Namibia	230,000
Ghana	180,000
Finland	68,000
Austria	60,000
Kazakhstan	50,000
Total	**97,318,000**

Although they contain lithium, some deposit types are not currently economically viable. Lithium, for instance, is present in some oilfield brines, as well as ocean brines in regions with geothermal activity, such as the western United States, Europe, New Zealand, and Iceland. In certain sedimentary clays, lithium is also present. Lithium production from oilfield brines, ocean brines, geothermal brines, and clays is still being investigated.[5]

Lithium Brines

Brine in salar deposits in South America (Bolivia, Chile, Argentina), the United States (Nevada), and the Chinese regions of Qinghai and Tibet contain high quantities of lithium.

One of the main sources of lithium compounds is salar brines. Large, dry lake beds known as salars are found high up in vast mountain ranges, where brines are found just beneath

[4] United States Geological Survey. (2023). *Lithium.* Lithium (usgs.gov)
[5] See: Lithium - International Lithium Association

a layer of crusted salt deposits. In salars, which are closed or restricted drainage basins where the rate of evaporation exceeds the rate of precipitation, lithium brines are found.

There are at least six common characteristics that provide indicators of lithium brine deposit genesis: (a) arid climate; (b) closed basin containing a salar (salt crust), a salt lake, or both; (c) associated igneous and/or geothermal activity; (d) tectonically driven subsidence; (e) suitable lithium sources; and (f) sufficient time to concentrate brine.[6]

Lithium brines produce lithium carbonate out of concentrated lithium chloride. Some brines' carbonate production is then processed further to produce lithium hydroxide.

Chile, Argentina, and Bolivia hold the largest and richest deposits of lithium brines. The lithium brines deposit in the Salar de Atacama, Chile, stands out in terms of production. Argentina, however, holds the vast majority of salar deposits of different sizes and grades. Lithium brine deposits in China and the United States have lower grades and a higher level of impurities, such as magnesium.

Figure 1. The world's largest producing lithium brine deposit, Salar de Atacama, Chile

Photo by Nicolas Maennling

See: Lithium brines: A global perspective (usgs.gov)[7] Lithium - International Lithium Association

Lithium Minerals

Lithium in minerals is found in several mineralization forms, such as lithium oxide (Li_2O). The main lithium-bearing minerals found in pegmatites are spodumene, petalite, lepidolite, amblygonite/montebrasite, and eucryptite. While there are over 140 minerals containing lithium, only a few are commercial sources of lithium, including spodumene, petalite, and lepidolite.

Mineral	Chemical Composition	% Li_2O
Spodumene	$Li_2OAl_2O_3(SiO_2)_4$	8
Lepidolite	$K(Li,Al)_3(Si,Al)_4O_{10}(F,OH)_2$	7.7
Polylithionite (Sonora)	$KLi_2Al(Si_4O_{10})(F,OH)_2$	7
Petalite	$Li_2OAl_2O_3(SiO_2)_8$	4.7
Zinnwaldite (Cinovec)	$KLiFeAl(AlSi_3)O(F,OH)$	2.19-3.72
Hectorite (Thacker Pass)	$Na_{0.3}(Mg,Li)_3Si_4O_{10}(OH)_2$	1.17

Source: iLiMarkets, 2023.

Lithium deposits from pegmatites contain a concentration range of lithium oxide from 1% to over 4%.[7]

In terms of production, spodumene is the most significant mineral containing lithium. This is due to the large deposits, relatively high lithium content, and relatively easy processing of the ores. Economically significant amounts of petalite and lepidolite are also recovered.[8] The processing of their concentrates is different from spodumene's concentrates. Many deposits contain both spodumene and petalite. In Africa, lithium minerals contain mostly petalite. Lepidolite is mostly produced in China. At the time of writing, spodumene is mostly produced in Australia.

Currently, Western Australia and China are the most important suppliers of these hard rock minerals. China also plays a dominant role in the processing of mineral concentrates. Almost all of Australian spodumene is currently processed into chemicals in China. Other countries may play a larger role as suppliers in the future, such as Zimbabwe and the DRC in Africa and Brazil in the Americas.

Up until the middle of the 1990s, spodumene was the main source of lithium used to produce lithium carbonate. Nowadays, lithium carbonate and lithium hydroxide are made from roughly 60% and 40% of spodumene, respectively.

Lithium mineral concentrates are used to produce either lithium carbonate or lithium hydroxide.

[7] Lithium - International Lithium Association
[8] Ibid.

Figure 2. The world's largest producing lithium minerals deposit, the Greenbushes Mine, Australia

Lithium Production Processes – Conventional Routes

The process to extract lithium and produce its chemical forms differs between brine and mineral extraction. Both can be economically viable. Brines and mineral extraction projects are found at different points of the lithium carbonate and lithium hydroxide cost curves.

The economic value of a lithium deposit is dictated by its behaviour in the different production processes. In general terms, lithium production leaves behind calcium, sodium, magnesium, potassium, boron, and other impurities that negatively affect the cost of refining the commercially valuable lithium components.

Lithium Brine Production

Lithium production from brines begins with the production of lithium chloride (LiCl) concentrate, which is then converted into lithium carbonate (Li_2CO_3) through a carbonization process. At an incremental cost, lithium hydroxide (LiOH) can be produced from lithium carbonate.

Lithium Concentration

The first phase of the lithium chemical production process is the evaporation and concentration of lithium, carried out in the evaporation ponds. The resulting brine concentrate is then sent to a chemical plant.

Lithium concentration in the brine is key to a salar's economic viability.[9] The lithium concentration defines the concentration factor and evaporation area. Experts currently see lithium concentrations of 450 parts per million (ppm) as the minimum for the brine to be commercially viable.

The most attractive salars are those with high lithium concentration and evaporation rates and low sulphate, magnesium, and calcium quantities. Evaporation rates rely on elevation and local climate. Each salar has a unique brine composition, which requires a specific flowsheet to recover the lithium. In addition, there are different conditions that can affect the technical and financial feasibility of exploiting a salar, such as climate, reservoir hydrogeology, reserves, infrastructure (electricity and accessibility), and freshwater availability.

Lithium brine production is characterized by the construction of pumping wells capable of extracting brine from different aquifers of interest. The brine extracted from each of the wells is accumulated in different gathering ponds that allow it to be distributed to evaporation ponds and, eventually, to metallurgical plants.

There are rarely any valuable by-products during this stage. As the brine moves through the ponds, different salts are precipitated. In the evaporation process, sulphate, potassium, calcium, and magnesium will concentrate together and must be removed before lithium chloride can be precipitated. These elements are considered waste for the most part. Only a few projects re-use some of them, such as the Salar de Atacama in Chile, which produces potassium chloride.

Lithium Carbonate Production

The second phase of the chemical process is carried out in the carbonate plant. To get purified brine, chemical treatments are applied to eliminate the traces of impurities remaining from the evaporation process, mainly boron, magnesium, and calcium:

- Boron – The brine is first pumped from the covered ponds to the solvent extraction plant in order to remove boron. The costs of reagents used in this stage, such as hydrochloric acid, sulphuric acid and caustic soda, can be material.

- Magnesium – The end liquor and brine are combined after the boron is extracted in order to precipitate the majority of the magnesium as magnesium carbonate. After filtering, the brine is transferred to the second stage of magnesium extraction. Magnesium is then reacted with a lime solution to precipitate the magnesium as magnesium hydroxide. The ratio of Mg/Li indicates how much magnesium must be removed.

- Calcium – To produce lithium carbonate, it is also necessary to precipitate calcium as calcium carbonate and/or calcium hydroxide.

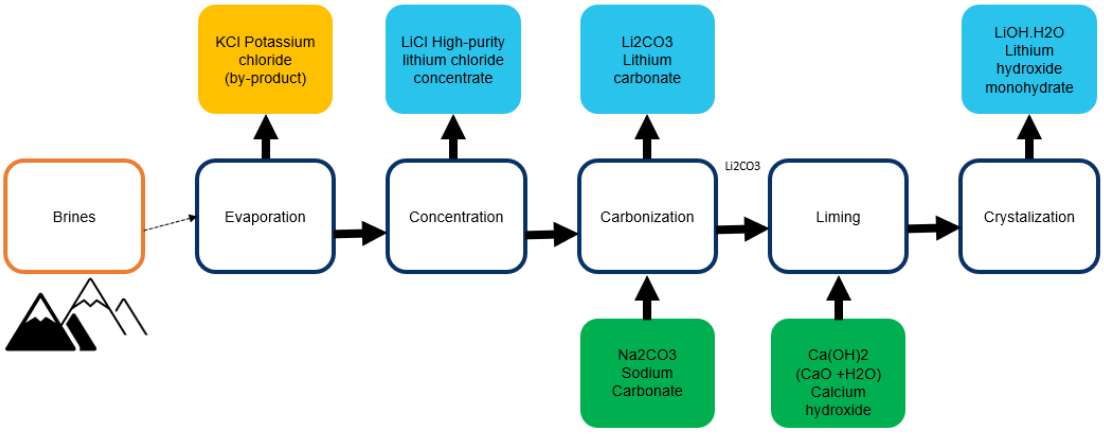
Next, the purified brine is sent to the lithium carbonate plant.

[9] See: Lithium concentrations in brines: instant, on-site measurements using handheld LIBS - International Mining (im-mining.com)

The major cost item in the production of lithium carbonate is the consumption of soda ash. Soda ash consumption is around 1.9 tonne/tonne of lithium carbonate. About 1.4 tonne of soda ash/tonne of lithium carbonate is used for the precipitation. About 0.4 tonne/tonne of lithium carbonate soda ash stays in the solution remaining after the lithium chloride has been precipitated. Lithium carbonate is precipitated by adding a soda ash solution to the purified lithium brine. After that, the lithium carbonate is dried after being filtered and cleaned on a belt filter[10].

Lithium carbonate plant yield is expected to be in the 75%–80% range. A portion is expected to fail to meet the prescribed specifications or standards (10%–20%), which requires further processing, either lithium carbonate refining or conversion into lithium hydroxide.

Figure 3. Lithium production process from brines – Process diagram



Source: iLiMarkets, April 2023.

Lithium Hydroxide Production From Lithium Carbonate

The main process to convert lithium carbonate to lithium hydroxide is called liming route.

It starts by reacting lithium carbonate with calcium hydroxide, where lithium hydroxide is obtained in an aqueous state. Calcium carbonate is obtained, as well as waste. The yields of this process average 85% of lithium hydroxide in aqueous state. At high temperatures, this reaction yields a solution containing approximately 2.25–2.75 % of lithium hydroxide monohydrate ($LiOH^* H_2O$). The insoluble residue (mainly calcium carbonate) is removed, and lithium hydroxide monohydrate) is crystallized from the remaining solution by

[10] See: WO2013036983A1 - Process for producing lithium carbonate from concentrated lithium brine - Google Patents

evaporation. After that, it is separated, and the water can be carefully dried out to yield anhydrous lithium hydroxide .

Lithium Minerals Production

Granitic pegmatites contain the most significant lithium-bearing minerals, spodumene being the most significant. The following processes are referred to lithium production from spodumene but mostly apply to other minerals like petalite and lepidolite.

Lithium production from minerals can be divided into two segments: first, mining and processing into concentrate forms. Second, refining into chemical forms.

Mining and processing of lithium minerals include extraction, milling processes, and dense media separation. Every mine produces a different type of lithium mineral concentrate (in terms of granulometry, grade, and contaminants). Refineries must be specifically fine-tuned to the concentrate they process.

Refining requires the calcination and acidification of the mineral to produce an acidic solution of lithium sulphate (Li_2SO_4), which can be reacted to produce lithium carbonate or lithium hydroxide at a similar cost. This is a major difference with brines. From the production of minerals, it is not necessary to produce lithium carbonate in order to produce lithium hydroxide.

Lithium Mining and Processing

Once the ore has been extracted by excavators and other mining vehicles, the concentration process starts by crushing the ore with high-pressure grinding rollers. Then, a coarse media separator, deslime, and magnetic separation are used to remove impurities, including iron, mica, and coarse grains. A flotation process can be added to produce a finer product. The process yields are in the order of 70% to 75%, with the aim of producing spodumene with 5.5% to 6% of lithium oxide concentration. The concentration plant is located at the mine sites, which can be in remote areas.

Transport costs can be a large cost component for lithium mineral concentrates. In Australia, some deposits are located as far as 500 km from the closest port, accessible by rail or truck. Assuming a transport cost of about USD 10/tonne per 100 km, this can add up to USD 40–50/tonne in the cost of spodumene exports.

Refining Lithium Carbonate From Spodumene

Spodumene concentrate is roasted at high temperatures to convert it to a more soluble form, specifically above 1000°C to convert α-spodumene to β-spodumene.[11] The spodumene is then ground and mixed with sulphuric acid to extract the lithium. The lithium sulphate obtained is solubilized by leaching with water. The resulting solution could then be purified through a series of processes, including precipitation, filtration,

[11] Alpha spodumene is the natural crystalline form (monoclinal) where Li is more heavily bound with other elements, whereas the beta spodumene is tetragonal, making the Li extraction easier.

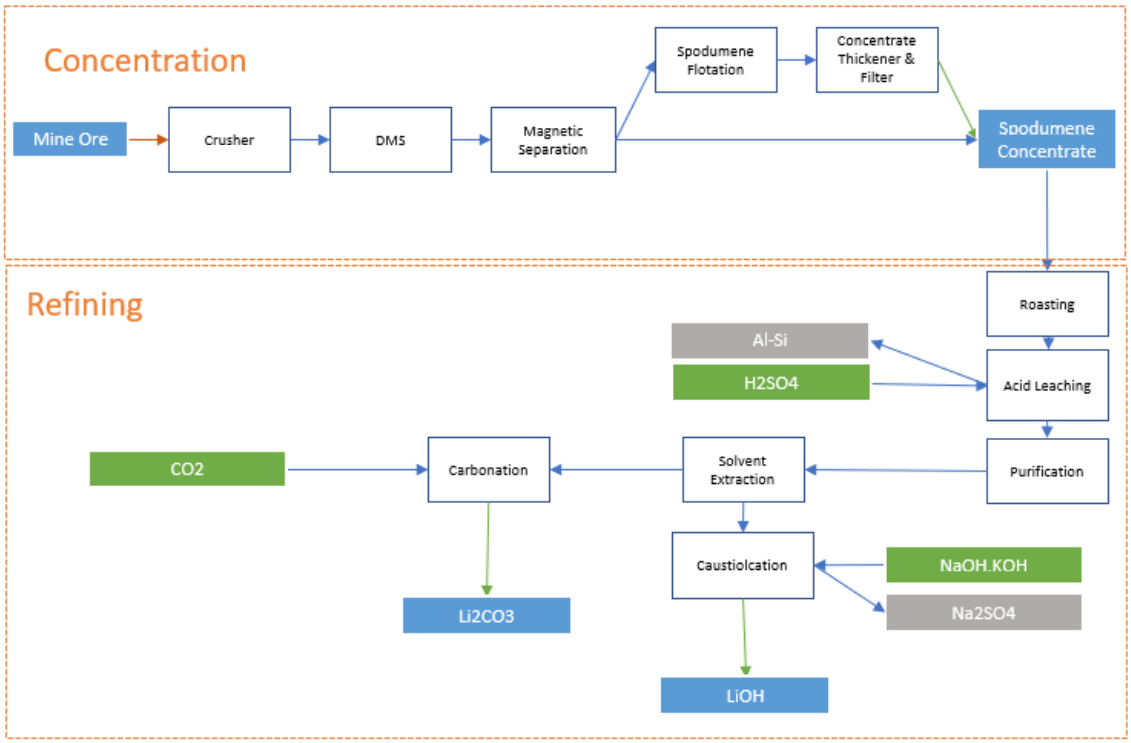
and ion exchange to remove impurities such as iron, magnesium, and calcium. Lithium carbonate is then precipitated out of the purified solution using soda ash treatment. The amount of soda ash required for this process is similar to that required for refining lithium carbonate from lithium chloride in brines. The lithium carbonate is filtered, dried, and packaged for sale. The operating costs of the refining process are largely dependent on the prices of spodumene, sulphuric acid, soda ash, and energy.[12]

Refining Lithium Hydroxide From Spodumene

The refining process is the same as for lithium carbonate up to the ion exchange columns. Sodium hydroxide is then added to convert the lithium sulphate into lithium hydroxide and generate sodium sulphate, which is crystallized. The yield is in the order of 80%–85% Li.

An important operating cost component is the cost of handling/transporting the solid waste from the refinery: 10–12 tonnes of waste per tonne of lithium hydroxide (including sodium sulphate). This requires either significant areas dedicated to waste dumping at the refining plant or additional logistical costs for the waste to be transported elsewhere.

Figure 4. Lithium production process from minerals – Process diagram



Source: iLiMarkets, April 2023.

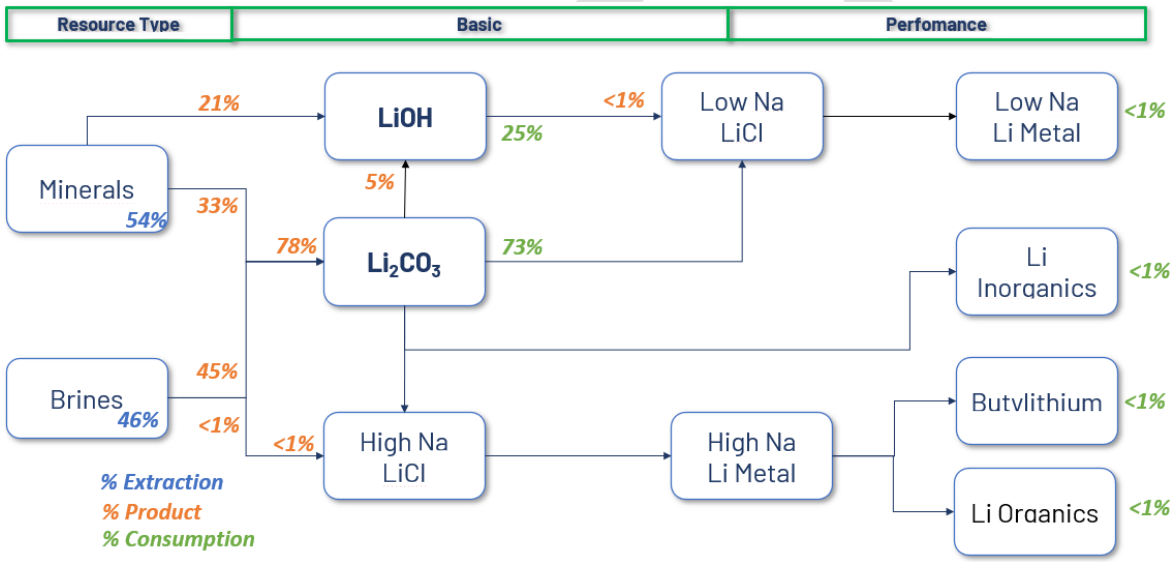
[12] See: lithium-and-cobalt-a-tale-of-two-commodities.ashx (mckinsey.com)

Lithium Production and Reserves

The following table provides an overview of the top lithium-producing countries and reserves.

Lithium production is still relatively small and concentrated but is expected to grow rapidly in the next decade. Six lithium mineral operations in Australia, one mineral tailings operation in Brazil, two lithium brine operations each in Argentina and Chile, and three mineral and two brine operations in China accounted for the majority of the global lithium production in 2023.[13] In recent years, lithium minerals have taken a growing share of the total lithium market. In 2022, lithium brines represented approximately 46% of the world's lithium production and lithium minerals represented 54%.

Figure 5. "Lithium Tree": Sources and destination of lithium chemicals



Source: iLiMarkerts, April 2023.

In 2022, production of lithium from brines was dominated by Chile (66%), China (22%), and Argentina (11%). Australia and China were the main producers of lithium from minerals.

[13] United States Geological Survey. (2023). *Lithium.* Lithium (usgs.gov)

Table 2. Lithium production and reserves (in tonnes of contained lithium)[14]

Country	2020	2021	2022	Reserves
Argentina	5,900	5,970	6,200	2,700,000
Australia	39,700	55,300	61,000	6,200,000
Brazil	1,420	1,700	2,200	250,000
Canada	N/A	-	2,200	930,000
Chile	21,500	28,300	39,000	9,300,000
China	13,300	14,000	19,000	2,000,000
Portugal	348	900	600	60,000
United States	-	-	-	1,000,000
Zimbabwe	417	710	800	310,000
Other countries[15]	-	-	-	3,300,000
World total	82,500	107,000	130,000	26,000,000

In 2023, six producers accounted for two thirds of global lithium carbonate equivalent (LCE) supply. Table 3 shows a five-year outlook for LCE production.

Table 3. The eight biggest lithium producers (in Kmt LCE) in 2022[16]

Main lithium producers	# of projects	Headquarters	Main origins of production
SQM	157	Chile	Chile, Australia
Albermale	140	United States	Australia, Chile, United States, China
Tianqi	77	China	China, Australia
Pilbara	51	Australia	Australia
Mineral Resources	28	Australia	Australia
Allkem	32	Australia	Argentina, Canada, Australia
Ganfeng	29	China	China, Australia, Mexico, Argentina, Mali, Ireland
Livent	23	United States	Argentina, China, United States

[14] Ibid.

[15] Other countries with reported reserves: Austria, DRC (Kinshasa), Czechia, Finland, Germany, Ghana, Mali, Mexico, Namibia, Serbia, and Spain.

[16] Announced production adjusted by iLiMarkets´ assessment.

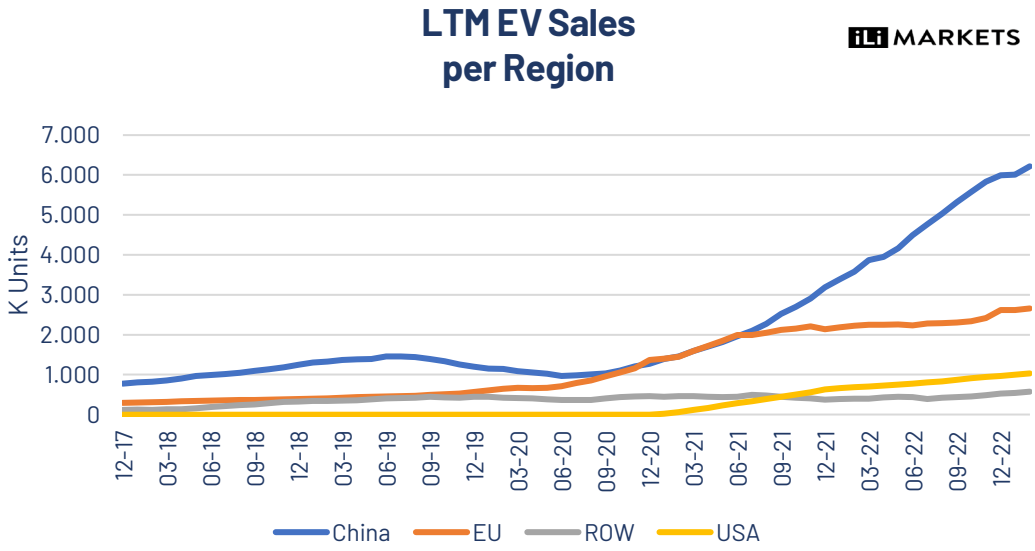
Most companies involved in brine extraction are integrated into the sale of lithium chemicals (carbonate or hydroxide) to third parties. Most companies involved in lithium mineral extraction are integrated into the sale of mineral concentrate, such as spodumene. In China, there is a high level of concentration in the processing and refining of lithium chemicals.

Lithium Pricing Fundamentals

Lithium is a metal that is valued for its lithium concentrate content, with the vast majority of lithium used for battery production. This means that demand for lithium has a close linkage to electric vehicles and, subsequently, battery production. Outside of batteries, lithium is used in other industrial applications, such as glass and ceramics, lithium grease lubricants, and aircraft construction.

Growth in electric vehicles continues to drive lithium demand. Global electric vehicle sales grew from 6.4 million in 2021 to 10.1 million in 2022 (+60%) and will reach 13.8 million–14.5 million by 2023 (~50%). A million electric vehicles consume between 40 and 50 kMT[17] LCE.[18] During 2022, LCE consumption in electric vehicles has grown by 150–200 kMT LCE. In 2022, China accounted for 60% of global electric vehicle sales.

Figure 6. Electric vehicles sales per region (LTM) from 2017 to 2022



Source: iLiMarkerts, April 2023.

Governments are increasingly encouraging the transition to electric vehicles by combining incentives with regulatory targets. Europe and China are reducing subsidies substantially in 2023. While the United States has offered consumers the possibility to

[17] Kilo metric tonne. It is equal to 1,000 metric tonnes or one million kilograms. Greenhouse Gas Reporting Help (ccdsupport.com)
[18] Lithium carbonate equivalent

claim as much as USD 7,500 in federal tax credits "if they purchase a clean-energy vehicle that satisfies certain US rules regarding critical minerals and battery components,"[19] its effects on demand are not yet clear.

In 2022, lithium represented between 75% to 85% of the cathode raw material costs, and it is present in all cathode chemistries (NCM 111, NCM 523, NCM 622, NCM 811, NCA,[20] LNO,[21] LFP,[22] LMO,[23] LMNO,[24] Li Anode).[25] Lithium carbonate is used to produce low-nickel cathodes, a type of lithium-ion batteries commonly used for electric vehicles (i.e., NCM, which stands for Lithium Nickel, Cobalt, Manganese oxide). Lithium hydroxide is used to produce high-nickel cathodes. The respective demand for low-nickel cathodes and high-nickel cathodes is constantly changing. At the time of writing, low-nickel cathodes are being adopted more widely (e.g., by leading electric vehicle producers, such as Tesla), leading experts to expect higher demand for lithium carbonate than lithium hydroxide in the future.

An important concept is the "lithium grade." A cathode producer might require technical-grade (industrial-grade) or battery-grade lithium carbonate and hydroxide. Lithium battery grade has a higher purity of lithium than lithium technical grade, i.e., 99.5% vs 99%. Battery-grade lithium generally has a lower level of impurities (i.e., sodium, sulphate, potassium, magnesium) and lower levels of magnetic particles (i.e., Fe, Cr, Ni, Zn.). In terms of particle size, lithium micronized battery grade is common, as opposed to lithium technical grade crystals or powder. The qualification processes differ: battery grades require longer qualification processes (i.e. Initiative for Responsible Mining Assurance, International Organization for Standardization, and other certifications required by Original Equipment Manufacturers [OEMs]). Refining lithium carbonate or hydroxide from technical-grade to battery-grade costs USD 1.5–2.5/kg on average, plus a yield loss of 3%-5%. This does not always lead to an equivalent gap in spot prices. There is typically a spot-price gap between battery grade and technical grade of USD 1–2/kg, which can increase when the market is oversupplied and decrease when the market is undersupplied.

Beyond the grade, there is no unique specification. Each cathode producer has specific requirements, and each producer has a different contaminant profile. Cathode producers will try to buy the products whose contaminant profiles are acceptable for their production process.

The structure of the market leads to similar prices for lithium carbonate and hydroxide. Lithium brines, on average, have lower operational costs in the production of lithium carbonate than lithium minerals. Lithium minerals, on average, have lower operational

[19] Text - H.R.5376 - 117th Congress (2021-2022): Inflation Reduction Act of 2022 | Congress.gov | Library of Congress

[20] Lithium nickel-cobalt-aluminum oxide
[21] Lithium nickel dioxide
[22] Lithium iron phosphate
[23] Lithium manganese oxide
[24] Lithium manganese nickel oxide
[25] Agregación de valor en la producción de compuestos de litio en la región del triángulo del litio (cepal.org)

costs in the production of lithium hydroxide than brines. However, the demand for lithium carbonate exceeds what competitive brine producers can provide to the market, and a significant share of lithium minerals is used to produce lithium carbonate. Economically, this only happens if the price of lithium carbonate is similar to the price of lithium hydroxide. Refiners that produce lithium chemicals from minerals produce both carbonate and hydroxide. Seeking to maximize prices, they end up balancing the market to match the demand for each product.

From an economic efficiency perspective, brine producers should only produce lithium carbonate. However, this is not always the case. Producers might want to diversify their customers, and vice versa, and some countries may make commercial choices to secure their place in the electric battery value chain.

Although the demand for lithium seems sustainable, there are some risks for non-lithium-ion batteries. For instance, in February 2023, Hina Battery and Sehol unveiled the first test vehicle with sodium-ion batteries.[26] Hydrogen and flow vanadium are other, albeit less likely, alternatives.

High lithium prices represent an increased recycling incentive. Recycling is expected to be a relevant source of supply from 2027 onwards once used lithium-ion batteries start to become available. Beyond 2030, recycling should account for an ever-increasing percentage of the total supply of lithium. The growth of the supply of primary lithium is therefore likely to decrease rapidly in the 2030s.

Components for an Agreement for the Sale of Lithium

Lithium can be sold either in chemical form, directly to cathode producers, or in mineral or concentrate form, to be refined into a chemical form. A very small percentage of lithium from brines is sold as lithium chloride concentrate to producers of lithium metal, used in specialty metals like Butyllithium. Such products are typically sold under a fixed price on long-term contracts and are out of the scope of this section and the ones following.

There are many forms of contracts for the sale and purchase of lithium. This section attempts to describe the main elements of these contracts between independent parties to help tax administrations in applying the arm's length principle. Sale and purchase contracts or agreements for lithium chemicals have the same structure but will contain different terms and conditions than those for lithium mineral concentrates because the product is different, as are the parties involved. They are therefore treated separately below.

Regardless of the type of lithium product, buyers request representative samples and check metallurgical and mineralogical characteristics before importing lithium chemicals, concentrates, or minerals. These characteristics are the basis of the contract and price negotiations.

[26] Hina Battery becomes 1st battery maker to put sodium-ion batteries in EVs in China - CnEVPost

Lithium Chemicals

Lithium carbonate and lithium hydroxide (monohydrate) are both used as inputs into cathodes for batteries, with similar lithium content—19% and 16.5%, respectively—and similar pricing mechanisms. Although the analysis in the following section tends to focus on lithium carbonate, most of it applies to lithium hydroxide as well.

Lithium is mostly sold in the form of either lithium carbonate or lithium hydroxide. There is currently a large and growing market for these products, which have become more uniform. Buyers can source their lithium chemicals from different sources, and sellers can sell their lithium chemicals to different customers. It is increasingly being sold as spodumene concentrate. So, in many ways, lithium products are traded as minerals in relatively opaque markets, like heavy minerals or bauxite.

As with any commodity, the terms and conditions that impact the price of a sales and purchase agreement are specific to that commodity. Lithium prices have historically been a one-on-one negotiation between the buyer—a plant that uses lithium products—and the seller—a production entity—with limited space for independent traders. This could change in the future as the market develops, but it will depend on the respective market structure of the producers and buyers of lithium chemicals.

The key components of a lithium chemical sales and purchase agreement are:

- Product description:
    - Whether it is lithium carbonate or lithium hydroxide: a cathode producer uses one or the other, depending on its specification. They are not interchangeable.
    - Battery grade or technical grade
    - Specifications not covered in the definition of the grade, i.e., chemical impurities, particle size profile
    - There are no price adjustments for products that do not meet the contract specifications. These could be rejected by the buyer, who is restricted by the processes of the cathode producer.
- Quantity involved: the quantity to be transferred from the seller to the buyer. Buyers and sellers typically engage in repeated sales and may increase the volume transacted over time. In principle, the volume transacted should impact price: a large buyer should be able to negotiate additional discounts. However, this has not always been the case in practice, as the price is usually determined by supply and demand factors. For example, in an undersupplied market, sellers have more options, and large buyers may be desperate to satisfy their cathode production needs and therefore would be willing to pay a premium to secure additional volume.

- Duration: determines whether it is a one-off, immediate (spot) sale, has a different delivery date (+30 days, +90 days, etc.), or is a contract for several batches at specific intervals over time (e.g., 1 year, 5 years). Many millions of tonnes of lithium carbonate may be delivered on a multi-year contract, typically a 3–7-year contract. Typically, multi-year contract prices are negotiated periodically or linked to price indices.

- Delivery terms: Depending on the arrangements negotiated between the buyer and seller, lithium carbonate can be sold at the delivery port, dispatch port, or an intermediate location. Typically, cost, insurance, and freight (CIF), or free carrier (FCA) incoterms are used when shipments go to Asia. Ex Works (EXW) can also be used for shipments to China. The FCA and delivery duty paid (DDP) incoterms are used when shipments go to Europe or North America. When contracts include variable prices with caps and floors, they typically use CIF multiple locations as a delivery condition.

Table 4. Incoterms in lithium contracts[27]

CIF	The cost of insurance and freight, duty-free, to the specified port of destination is covered by the seller. As soon as the goods are placed inside the ship, risk is transferred.
Free carrier (FCA)	The buyer supplies the carrier, and the seller is in charge of delivering the item into their custody. As soon as loading occurs, risk is transferred.
Ex Works (EXW)	The seller is only responsible for making the goods available at the seller's premises. From that point on to the destination, the buyer assumes all risk.
Delivery duty paid (DDP)	It is the seller's responsibility to transport the goods to the destination port, pay any applicable duties, and give the buyer access to them. As soon as the buyer has access to the goods and they are prepared for unloading at the designated location, risk is transferred.

- Price – in contracts, sellers and buyers can agree to a price that is fixed, variable, or variable with caps and floors.

    - Fixed prices – Standard contracts used fixed prices until around 2016, while the market was relatively stable. Prices were fixed from 1 to 3 years. With high price volatility, these contracts became a bet on future prices, with one party winning and the other losing as a result. Only a minority of contracts still used fixed contracts at the time of writing.

    - Variable prices – Sellers and buyers agree on a base price adjusted by an index, where the index is derived from assessments by leading price-

[27] Incoterms – TOP

reporting agencies (one or multiple, such as Benchmark, Fastmarket, or S&P Platts) or trade statistics, plus/minus discount/premium from that index of -15% to +5%. The contract can specify a yearly, biannual, quarterly, or even monthly price update. Prices are usually linked to indices reported for previous period(s). Recent contracts use an average of the prices from the 21st of the previous month to the 20th of the month of sale.

- Variable prices with caps and floors – where variable prices with caps and floors exist in contracts, the average duration is from 3 to 7 years. The base price is also adjusted by an index derived from assessments of price-reporting agencies or trade statistics minus a discount or plus a premium (typically -15% to +5%). The cap becomes active if the variable price exceeds the cap price, and the floor becomes active if the variable price is lower than the floor price. There are price reviews if the cap or floor prices go out of a certain previously agreed range.

In general, in long-term contracts, there are clauses to review the price every 3 months or monthly.

- Quotational period – When referring to a price index or assessment, the quotational period is subject to negotiation between the parties. Buyers and sellers may attempt to game the quotational period—for example, if the contract price is the lagged spot price from the previous quarter, the buyer may try to delay its purchase if the spot price is going down. Newer contracts use different quotational periods to address this problem, such as monthly updates or quarterly averages.

- Premiums or discounts – When referring to a price index or assessment, prices may include premiums or discounts above/below a price index or assessment. The quantum of any premium and discount is usually set by the market dynamics of when the contract is entered into. Another factor is the contaminant profile of lithium carbonate or hydroxide, which is specific to a producer and should not vary over time, therefore the premium or discount is negotiated upfront in the contract between the buyer and the seller. If a product has a high level of contaminants, the producer will get a lower price for the lithium concentrate. A producer with a better-quality product has more options and can get a premium.

- Payment conditions – These depend on the agreed delivery term. For instance, if the contract uses CIF, payment should be made within 30 days of the shipping date; if the contract uses DDP, payments could be extended, such as 90 days of the delivery/invoicing date. Payments could be made against a letter of credit.

Lithium Mineral Concentrates

Lithium minerals, such as spodumene, are sold by miners in the form of concentrate. They are an intermediate product. Buyers buy the concentrate for its lithium content, and it is

used in refineries to produce either lithium carbonate or lithium hydroxide. Therefore, the payable mineral is the lithium oxide contained in the concentrate.

- Type of mineral or concentrate. At the time of writing, most mineral concentrates sold are spodumene. In future, it is expected that more contracts will be entered into for petalite and lepidolite concentrates when refineries adjust their processes to be able to utilize these minerals, and miners develop these deposits.
- Lithium oxide content is specified in contracts. It is the most important determinant of spodumene prices. The price can be adjusted upwards or downwards if the product differs from the specification on a linear basis, as long as it meets a minimum threshold, e.g., 4.2% of lithium oxide from spodumene or 2.5% of lithium oxide from lepidolites.
- Specifications – There is no premium or penalties in the sale of lithium concentrate, like there is for copper or gold concentrates, impurities, or valuable by-products. The price is only based on lithium oxide content. The contaminants are important to determine if the specifications are met or not—if they are not, the product is rejected by the buyer. However, the buyer can negotiate the lithium concentrate price based on a contaminant profile.

Other factors that influence the price of the lithium mineral concentrates could include incoterms, volume, quotational period, and duration, which do not differ substantially from lithium chemicals, besides the packing of the lithium mineral concentrates, which can be delivered in bulk.

Determining the Price of Lithium

In the early 2000s, determining a price for lithium was inherently difficult due to the lack of global trade for lithium. In recent years, due to the growth of lithium chemical and concentrate trade, several pricing data agencies have started collecting price intelligence and publishing lithium chemical and concentrate prices. Driven largely by Asian imports, the availability of pricing data has increased, thereby facilitating the price-discovery process and allowing the development of lithium price indices. Lithium pricing data is published by price-reporting agencies such as Fastmarket, S&P Platts, Argus Media, Benchmark Intelligence, and Asian Metal and can be accessible through a subscription.

Price-reporting agencies have their own published methodology to develop spot and/or contract prices. The methodology is based on a range of factors, such as actual third-party transactions, bids and offers, and market intelligence—i.e. calls and other communication methods, such as emails to buyers and sellers. Neither indicator is a perfect reflection of market prices, although this is expected to change as the market grows rapidly in coming years and the price indices become more reliable.

Spot prices have long been based on a small volume of transactions. As of 2023, spot sales had been increasing mostly within China, and into China, Japan, and Korea. In coming years, spot sales should increase significantly in various markets as additional supply and buyers come online, which will make reported spot prices by price-reporting agencies more accurate reflections of market prices.

The reported contract price may reflect actual prices in sales contracts, but these are composed of old and new contracts, some of which are based on a fixed price, which might differ significantly depending on when they were negotiated, the volume involved, and the quality of the lithium sold. As such, reported contract prices tend to be significantly different than spot prices.

The availability of pricing indices themselves does not represent a substitute for an arm's-length price that would be agreed between independent parties. It does, however, present a reliable starting point for price-discovery purposes.

In order to determine whether it is appropriate to use such indices, it must be first established whether independent parties in negotiations use these indices and, if so, to what extent. From interviews with price-reporting agencies and market experts, it can be concluded that many buyers and sellers of lithium chemicals and concentrates do use price indices in their negotiations. Depending on market conditions, a discount or a premium to the price index or assessment can be negotiated. For instance, discounts are often negotiated when market prices are going down, and premiums are when market prices are going up. Tax authorities should account for market conditions prevailing at the time of a transaction when using price indices as a basis for an arm's-length price.

Lithium Price Indices

Price-reporting agencies report lithium chemicals and concentrate prices. The most used references are Fastmarket, S&P Platts, Shanghai Metal Market, and Asian Metals, followed by Benchmark Minerals Intelligence and Argus Media.

Almost all agencies publish spot-price assessments in importing countries, particularly China, Japan, and Korea. In China, they are able to distinguish between domestic sales, typically priced on a DDP incoterm basis, and imports, priced on a CIF basis. Agencies with access to knowledge of commercial contracts also report contract prices. Asian Metals and Benchmark Minerals also publish free on board (FOB) price assessments for some of the major exporting regions: North and South America, and, along with S&P Platts, Australia for spodumene exports.

As the lithium market is still relatively opaque and open trades are limited, some price-reporting agencies report assessments of price ranges or the middle of a price range rather than a single market price. Other price-reporting agencies report an assessment daily for certain price assessments, as they are confident there is enough liquidity in the market. These are price assessments, not price indices, strictly speaking. They are not observed in a fully transparent market where most bids, offers, and transactions are public, like a metal exchange. The price-reporting agencies publish price assessments based on a range of factors, such as individual contacts or transactions, bids and offers, and communications with producers, buyers, sellers, and other market agents. Through their networks, they have access to valuable information and produce price assessments following rigorous methodologies, most of them complaint with the International Organization of Securities Commission (IOSCO).[28] Full details of the price methodologies

[28] https://www.iosco.org/

followed by price-reporting agencies are published on their websites and/or available upon request.

At the time of writing, the only markets large enough to produce reliable market assessments for lithium chemicals in price-reporting agencies' publications are in Asia: China, Japan, and Korea, representing together over 90% of traded volumes of lithium. Given the size of Australia as a producer of lithium mineral concentrate and the diversity of buyers, an FOB Australia price for spodumene concentrate may also represent a relatively liquid market.

The lithium market is growing and changing fast. It is expected that price-reporting agencies will keep adjusting their price methodologies as the market evolves. For example, growing producing regions may see dedicated FOB price indices, and growing buying regions may see new CIF, DDP, Ex Works, or other relevant price indices. Price assessments for deliveries in Europe and North America that have been recently created may become more representative of market prices when these regions become more important buyers of lithium chemicals. Tax administrations should keep abreast of these developments. This means, for example, adjusting their transfer pricing analyses to market conditions applicable during an audit period or taking a forward-looking approach in negotiating Advanced Pricing Arrangements or safe harbours.

Fastmarket[29]

Fastmarket is a price-reporting agency that reports lithium carbonate and lithium hydroxide price assessments on a North Asian (China/Japan/Korea) CIF basis, Europe DDP basis, and domestic China EXW (value-added tax [VAT] included) basis since 2017. It also reports spodumene prices on a China CIF basis. Most spot prices are reported weekly, and contract prices are reported monthly, except the two most liquid markets, lithium carbonate and lithium hydroxide battery grade, delivered China/Japan/Korea CIF, which are reported daily.

Fastmarket's price methodology explains the assessment process.[30] It uses the following assessment price definition: "The prevailing level at which a commodity of stated specification has or could be expected to have transacted over a defined period of time." After collecting numerous data points on lithium transactions—as well as offers, bids, transactions heard second hand, and indications, they assign different weights to transactions depending on how confident they are that those data points reflect the open and competitive market, normalize prices for different types of commercial conditions, and discard the data points they deem less confident and significant. Publication is done daily, weekly, or monthly, depending on the products, after a standardized peer review process, with opportunities for correction if required.

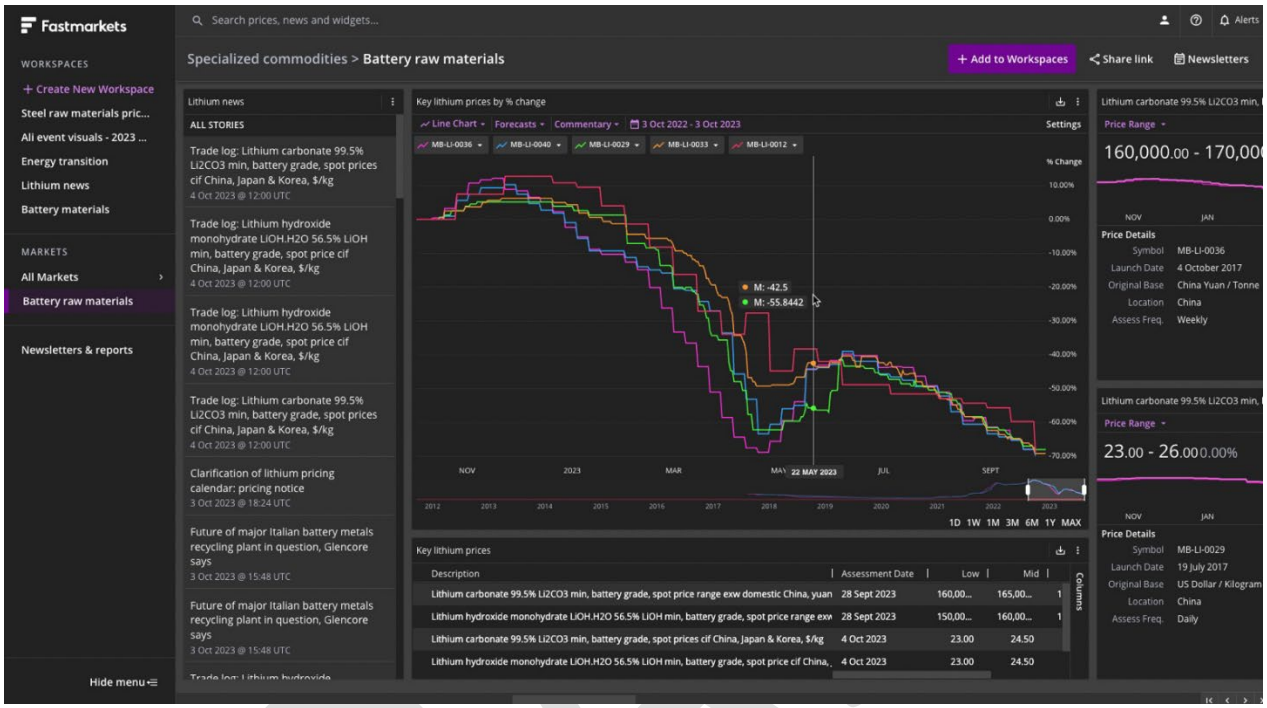
[29] Fastmarket. Lithium prices. Accessed 12 September 2023. https://www.fastmarkets.com/newgen/battery-materials/lithium/lithium-prices
[30] Fastmarket. Methodology and price specifications – September 2022. Accessed August 2023, https://cdn.fastmarkets.com/26/8c/dbcee48b4e8a9bce5fbf58cb8429/fm-mb-lithium.pdf

Table 5. Fastmarket lithium price assessments [31]

Product	Incoterm	Type	Unit	Location	Frequency
Min 99.5% Li_2CO_3, battery grade	CIF	Contract	USD/kg	China/Japan/ Korea	Monthly
	CIF	Spot	USD/kg	China/Japan/ Korea	Daily
	EXW	Spot	CNY/tonne	Domestic China	Weekly
	DDP	Contract	USD/kg	Europe	Monthly
	DDP	Spot	USD/kg	Europe	Weekly
Monohydrate 56.5% $LiOH.H_20$ min, battery grade	EXW	Spot	CNY/tonne	Domestic China	Weekly
	CIF	Contract	USD/kg	China/Japan/ Korea	Monthly
	DDP	Contract	USD/kg	Europe	Monthly
	DDP	Spot	USD/kg	Europe	Weekly
	CIF	Spot	USD/kg	China/Japan/ Korea	Daily
Monohydrate 56.5% $LiOH.H_20$ min, technical and industrial grades	DDP	Contract	USD/kg	Europe	Monthly
	DDP	Spot	USD/kg	Europe	Weekly
	CIF	Contract	USD/kg	China/Japan/ Korea	Monthly
	CIF	Spot	USD/kg	China/Japan/ Korea	Weekly
	EXW	Spot	CNY/tonne	Domestic China	Weekly
Min 99% Li_2CO_3, technical and industrial grades	CIF	Contract	USD/kg	China/Japan/ Korea	Monthly
	CIF	Spot	USD/kg	China/Japan/ Korea	Weekly
	EXW	Spot	CNY/tonne	Domestic China	Weekly
	DDP	Contract	USD/kg	Europe	Monthly
	DDP	Spot	USD/kg	Europe	Weekly
Spodumene min 6% Li2O	CIF	Spot	USD /tonne	China	Fortnightly
	CIF	Contract	USD /tonne	China	Monthly

[31] Fastmarket. Lithium prices. Accessed 12 September 2023. https://www.fastmarkets.com/newgen/battery-materials/lithium/lithium-prices

Figure 7. Fastmarket lithium price assessments



Source: Fastmarket, personal communication.

S&P Platts[32]

S&P Global Platts reports carbonate, hydroxide, and spodumene prices. Its lithium carbonate and hydroxide prices, which represent actual spot market prices for battery-grade material, are evaluated every day on a CIF North Asia, CIF Europe, and DDP China basis. Additional attributes are considered and could be adjusted to return to the base standard specifications of S&P Global Commodity Insights. The lithium spodumene price is assessed weekly on an FOB Australia basis, reflecting physical spot market prices with a minimum of 6% lithium oxide content exported from Western Australian ports.

S&P Global Platts publishes its general pricing methodology,[33] as well as a price specifications guide for nonferrous metals.[34] It collects information on bids/offers and deals, verifies the information with market participants, normalize prices when required, and discards non-representative data. It also publishes individual data points that are the

[32] S&P Global. Commodity Insights. Battery Metals. Accessed 12 September 2023. https://www.spglobal.com/commodityinsights/en/our-methodology/price-assessments/metals/battery-metals
[33] S&P Platts. Platts Assessments Methodology Guide. June 2023. https://www.spglobal.com/commodityinsights/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/platts-assessments-methodology-guide.pdf
[34] S&P Platts. Specifications Guide Global Nonferrous Metals. September 2023. https://www.spglobal.com/commodityinsights/en/our-methodology/methodology-specifications/metals/nonferrous-methodology

basis for their assessment, such as actual transactions and bids and offers, so-called "heards," accessible through free registration.[35]

Table 6. S&P Platts lithium prices [36]

Product	Incoterms	Unit	Location	Frequency
Lithium Carbonate Min 99.5% Li2CO3	CIF	USD /tonne	North Asia	Daily – 16:30 SG
Lithium Carbonate Min 99.5% Li2CO3	CIF (import parity)	CNY /tonne	North Asia	Daily – 16:30 SG
Lithium Carbonate Min 99.5% Li2CO3	DDP	CNY /tonne	China	Daily – 16:30 SG
Lithium Carbonate Min 99.5% Li2CO3	CIF	USD/tonne	Europe	Daily – 16.30 UK
Lithium Hydroxide Min 56.5% LiOHH20	CIF	USD /tonne	North Asia	Daily – 16:30 SG
Lithium Hydroxide Min 56.5% LiOHH20	DDP	CNY /tonne	China	Daily – 16:30 SG
Lithium Hydroxide Min 56.5% LiOHH20	CIF	USD/tonne	Europe	Daily – 16.30 UK
Lithium Spodumene Min 6% Li20	FOB	USD /tonne	Australia	Friday – 16:30 SG

Shanghai Metal Market [37]

Shanghai Metals Market (SMM) is a comprehensive online marketplace offering both ferrous and nonferrous metals. Focused on the Asian markets, and the Chinese market in particular, SMM publishes price assessments for lithium carbonate and hydroxide, battery grade and industrial grade, as well as lithium metal, spodumene concentrate, and different types of lithium-bearing minerals.

SMM publishes methodological notes for its different price indices, which include battery-grade lithium carbonate and lithium hydroxide.[38] For instance, for the SMM battery-grade lithium carbonate price index assessment, a note contains standards and management methods: "These standards are formulated to establish a transparent and verifiable SMM price setting mechanism and provide market participants with an important pricing reference."[39] An SMM Price Administration Committee provides oversight on the methodology and its implementation.

SMM analysts collect price data information from multiple sources, confirm them with market participants, and assess/rank their reliability. They also discard non-reliable data.

[35] E.g., Platts China Lithium Heards. https://www.spglobal.com/commodityinsights/en/our-methodology/price-assessments/metals/china-lithium-assessment, accessed September 12 2023
[36] S&P Global. Commodity Insights. Battery Metals. Accessed 12 September 2023. https://www.spglobal.com/commodityinsights/en/our-methodology/price-assessments/metals/battery-metals
[37] SMM Lithium prices. Accessed 12 September 2023. https://www.metal.com/price/New%20Energy/Lithium
[38]SMM Benchmark Methodologies. Accessed 12 September 2023. https://www.metal.com/comp/methodology
[39] SMM_#1_Nickel_Spot_Price_Methodology.pdf

For example, "prices resulting from transactions between affiliated enterprises, sell-offs under financial or legal pressure and any other non-repeatable trading practices." They normalize the price data in order to publish a spot-price index assessment. SMM price index meets IOSCO principles.[40]

SMM publishes price assessments for other lithium products beyond carbonate and hydroxide battery grade, which follows the same methodologies as other leading pricing indices, but there is no publicly available methodological note.

Table 7. SMM lithium prices (all price ranges including VAT) [41]

Product	Incoterms	Unit	Location	Frequency
Lithium carbonate (99.2% industry level zero/domestic)	EXW	CNY /tonne	China	daily
Lithium carbonate (99.5% battery grade/domestic), magnetic content ≤0.003%	EXW	CNY /tonne	China	daily
Lithium hydroxide monohydrate (56.5% industry grade/domestic)	EXW	CNY /tonne	China	daily
Lithium hydroxide monohydrate (56.5%, battery grade, coarse particle/domestic), $LiOH•H_2O$≥98%, particle size of battery-grade lithium hydroxide is in the range of 300-400 microns	EXW	CNY /tonne	China	daily
Lithium metal (≥99%, industrial, battery/domestic)	EXW	CNY /tonne	China	daily
Lithium metal (battery grade): Li≥99.9%	DDP	CNY /tonne	China	daily
Spodumene concentrate (6%, CIF China): Lithium oxide 5.5-6%2525, prices converted proportionally 6%	CIF	USD/tonne	China	daily

Other ore prices reported by SMM but not subject to a rigorous price assessment:

- Spodumene（Li_2O:1.2%-1.5%） (weekly update) (USD/mt)
- Spodumene（Li_2O:2%-2.5%）(weekly update) (USD/mt)
- Spodumene（Li_2O:3%-4%）(weekly update) (USD/mt)
- Lepidolite（Li_2O:1.5%-2.0%） (USD/mt)
- Lepidolite（Li_2O:2.0%-2.5%） (USD/mt)
- Montebrasite（Li_2O:6%-7%） (USD/mt)
- Montebrasite（Li_2O:7%-8%） (USD/mt)

[40] https://www.metal.com/comp
[41] SMM Lithium prices. Accessed 12 September 2023. https://www.metal.com/price/New%20Energy/Lithium

Table 8. SMM lithium prices on September 28, 2023

Lithium compound | Lithium ore

Price description	Price Range	Avg.	Change	Date
Spodumene Domestic China (Li2O:5%-5.5%) (RMB/mt)	12,200-14,500	13,350	-150	Sep 28, 2023
Spodumene Domestic China (Li2O:4%-5%) (RMB/mt)	10,200-13,750	11,975	-125	Sep 28, 2023
Spodumene Domestic China (Li2O:3%-4%) (RMB/mt)	6,300-11,300	8,800	-300	Sep 28, 2023
Spodumene (Li2O:1.2%-1.5%) (weekly update) (CNY/mt)	1,292.36-1,615.46	1,453.91	-143.6	Sep 28, 2023
Spodumene (Li2O:2%-2.5%) (weekly update) (CNY/mt)	2,189.84-3,015.52	2,602.68	-179.5	Sep 28, 2023
Spodumene (Li2O:3%-4%) (weekly update) (CNY/mt)	5,097.66-6,641.32	5,869.49	-538.49	Sep 28, 2023
Lepidolite (Li2O:1.5%-2.0%) (CNY/mt)	1,950-3,800	2,875	-50	Sep 28, 2023
Lepidolite (Li2O:2.0%-2.5%) (CNY/mt)	3,800-5,400	4,600	-100	Sep 28, 2023

Source: SMM, personal communication.

Asian Metal[42]

Asian Metal collects mineral and metal prices from direct phone communications with market participants: producers, consumers, traders, and governments. It includes prices of deals just closed, being closed, or under negotiation in the spot market.

Asian Metal publishes the lithium prices in the table below as price ranges. It publishes prices on a wider range of products than other agencies. In particular, it publishes lithium metal prices, lithium chloride, lithium cobaltate, lithium manganate, and other battery inputs, such as lithium-nickel-cobalt-manganese oxide (LNCMO).

Asian Metal produces a general price methodology note applicable to all the mineral and metal prices published by the agency. The methodology is not publicly available but is available from the agency upon request. There is no publicly available methodological note on specific lithium price assessments.

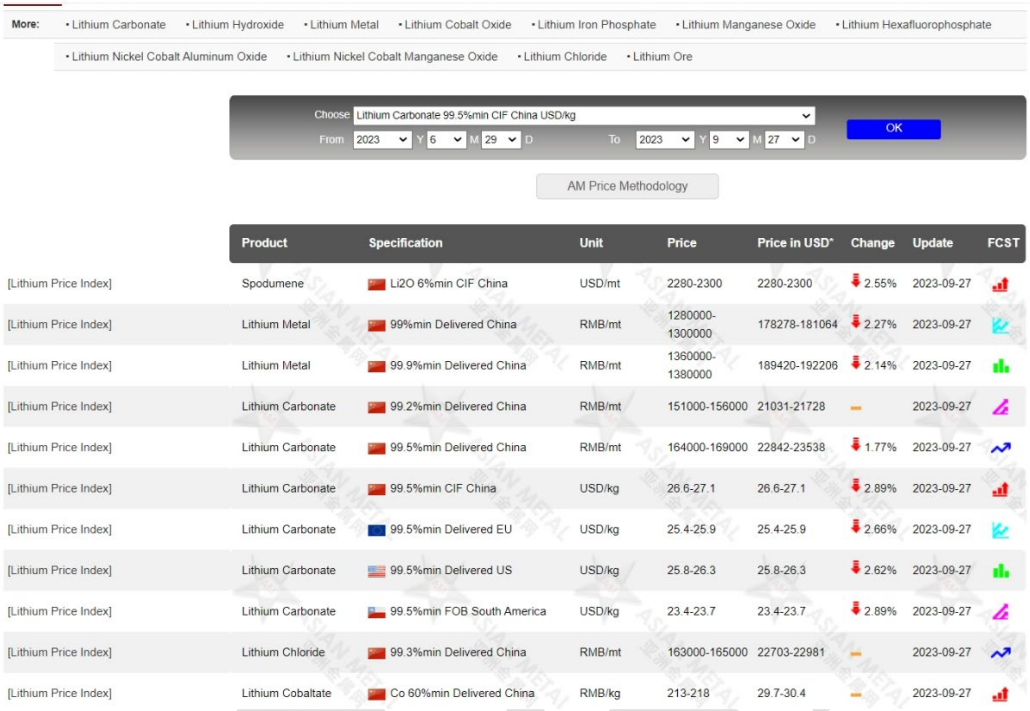
[42] Asian Metal. Lithium Price Index. Accessed September 15 2023. https://www.asianmetal.com/Lithium-Price/

Table 9. Asian Metal lithium prices[43]

Product	Incoterms	Unit	Location	Frequency
Lithium carbonate: 99%min	delivered	CNY/tonne	China	Unknown
Lithium carbonate: 99.5%min	delivered	CNY/tonne	China	Unknown
Lithium carbonate: 99.5%min	CIF	USD/kg	China	Unknown
Lithium carbonate: 99.5%min	delivered	USD/kg	EU	Unknown
Lithium carbonate: 99.5%min	delivered	USD/kg	US	Unknown
Lithium carbonate: 99.5%min	FOB	USD/kg	South America US	Unknown
Lithium Hydroxide Monohydrate: LiOH 56.5%min	delivered	CNY/tonne	China	Unknown
Lithium Hydroxide Monohydrate: LiOH 56.5%min magnets 0.0001%max	delivered	CNY/tonne	China	Unknown
Lithium Hydroxide Monohydrate: LiOH 56.5%min magnets 0.0001%max	FOB	USD/kg	China	Unknown
lithium Hydroxide Monohydrate: LiOH 56.5%min, magnets 0.0001%max	delivered	USD/kg	South Korea	Unknown
Lithium metal: 99% min	delivered	CNY/tonne	China	Unknown
Lithium metal: 99.9% min	delivered	CNY/tonne	China	Unknown
Spodumene: Li2O 6%min	CIF	USD/tonne	China	Unknown
Lithium Chloride: 99.3%min	delivered	CNY/tonne	China	Unknown
Lithium Cobaltate: Co 60%min	delivered	CNY /kg	China	Unknown
Lithium manganate: Mn 58%	delivered	CNY/tonne	China	Unknown
Lithium Iron Phosphate: Li 3.9%min	delivered	CNY/tonne	China	Unknown
LNCMO, 523	delivered	CNY/tonne	China	Unknown
LNCMO, 622	delivered	CNY/tonne	China	Unknown

[43] Asian Metal. Lithium Price Index. Accessed September 15 2023. https://www.asianmetal.com/Lithium-Price/

Figure 8. Asian Metals lithium prices



Source: Asian Metals, personal communication.

Benchmark Minerals Intelligence (BMI) [44]

BMI is a relatively newer price-reporting agency that specializes in the lithium and lithium-ion battery supply chain. In addition to a limited number of spot-price assessments, it publishes six contract-based lithium carbonate, four lithium hydroxide, and one spodumene concentrate price assessments. Furthermore, BMI calculates the world average prices for lithium hydroxide and carbonate as well as a lithium chemical index that is weighted by market volume traded.

BMI publishes a dedicated methodology on its lithium prices, with a detailed explanation of each price assessment. [45] Prices are assessed on a bi-weekly basis for contract prices and a weekly basis for spot prices in the most liquid markets (EXW China and CIF Asia). The assessment follows an IOSCO-certified methodology that is uniquely designed for the lithium market, which is based on transactions recorded in the market, bids and offers, and confirmation from market participants. This is followed by an internal review process and a process for correction and revisions if required.

BMI publishes the following lithium price assessments for lithium carbonate, lithium hydroxide, and spodumene.

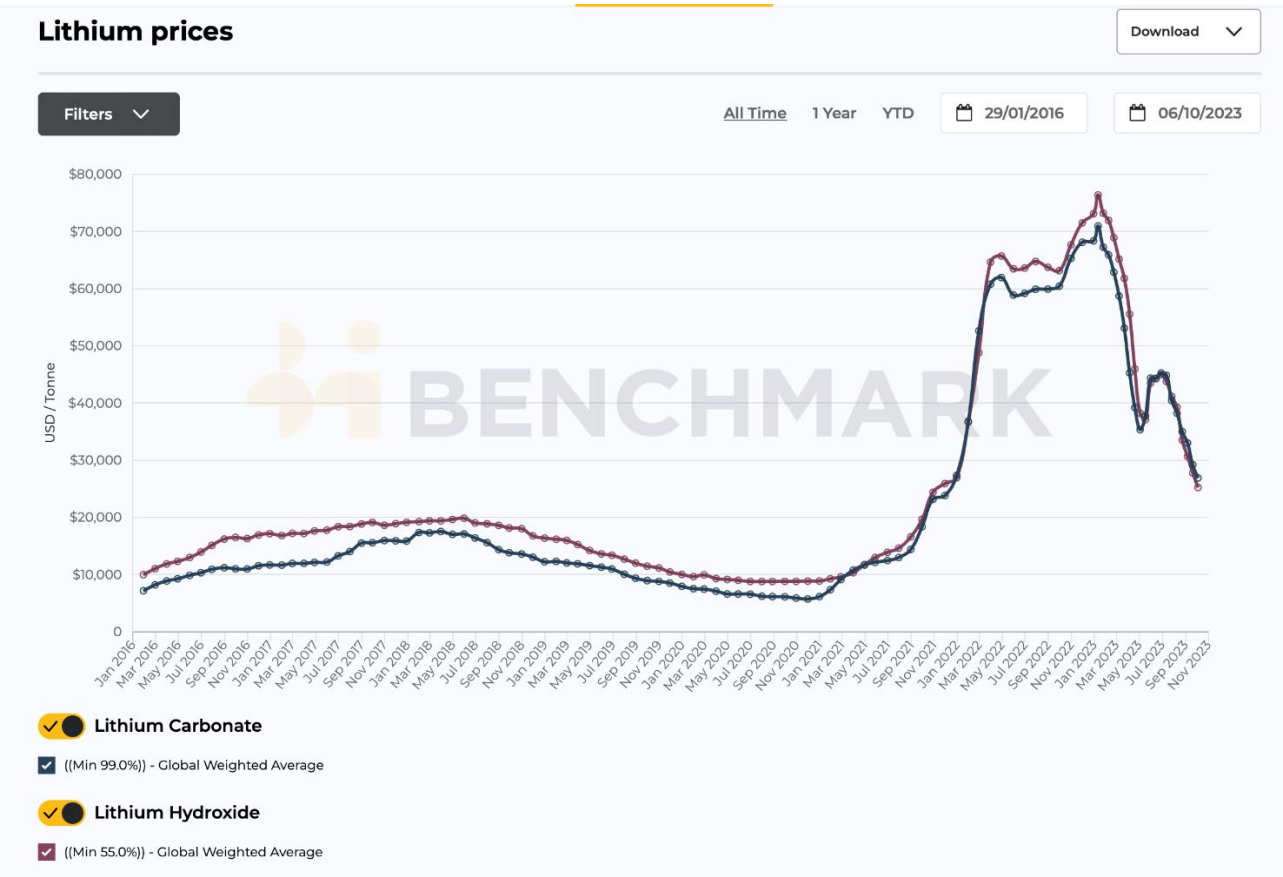
[44] Lithium Price Assessments | Benchmark Mineral Intelligence (benchmarkminerals.com)
[45] Benchmark Mineral Intelligence. Lithium Price Assessments. Accessed September 15 2023. https://www.benchmarkminerals.com/price-assessments/lithium/

Table 10. Benchmark Minerals Intelligence lithium prices [46]

Product	Incoterm	Type	Unit	Location	Frequency
Li_2CO_3 Min 99.2%	CIF	Spot	USD/tonne	Asia (Japan, South Korea, China)	Weekly
Li_2CO_3 Min 99.2%	CIF	Contract	USD/tonne	Asia (Japan, South Korea, China)	Fortnightly
Li_2CO_3 Min 99%	CIF	Contract	USD/tonne	Europe (German ports)	Fortnightly
Li_2CO_3 Min 99%	CIF	Contract	USD/tonne	US East Coast	Fortnightly
Li_2CO_3 Min 99%	FOB	Contract	USD/tonne	South America (Antofagasta)	Monthly
Li_2CO_3 Min 99.5%, battery-grade	EXW, VAT Included	Spot	CNY/tonne	China (domestic)	Weekly
Li_2CO_3 Min 99%, technical grade	EXW, VAT Included	Spot	CNY/tonne	China (domestic)	Weekly
LiOH Min 56%	FOB	Contract	USD/tonne	North America (Charleston)	Fortnightly
LiOH Min 56.5%	CIF	Spot	USD/tonne	Asia (Japan, South Korea, China)	Weekly
LiOH Min 56.5%	CIF	Contract	USD/tonne	Asia (Japan, South Korea, China)	Fortnightly
LiOH Min 56%	CIF	Contract	USD/tonne	Europe (Rotterdam)	Fortnightly
LiOH Min 56%	CIF	Contract	USD/tonne	US East Coast	Fortnightly
LiOH Min 56.5%	EXW, VAT Included	Spot	CNY/tonne	China (domestic)	Fortnightly
Spodumene concentrate Li_2O content 6%	FOB	Spot	USD/tonne	Australia (Bunbury)	Fortnightly

[46] Lithium Price Assessments | Benchmark Mineral Intelligence (benchmarkminerals.com)

Figure 9. BMI lithium prices



Source: BMI, personal communication.

Argus Media[47]

Argus is an important price-reporting agency recognized by a large number of commodities. It is a more recent publisher of lithium price assessments. In 2018, Argus introduced two fresh evaluations of lithium: lithium hydroxide, 56.5% (battery grade, FOB China) and lithium carbonate, 99.5% (battery grade, CIF China). It now reports other lithium chemicals and spodumene prices. Argus reports a distinct seaborne China price for lithium, having established that China is the biggest, if only, liquid spot market. All prices are reported on a spot basis only.

Argus lithium price assessments are tailored for specific market conditions through direct industry consultation. A methodological note for all battery materials is available on their website.[48] The process is similar to other price-reporting agencies. Argus collects information on transactions, bids and offers, and other market information to include spread values between grades, locations, timings, etc. The data is verified by price reporters and assessed and reviewed before publication.

[47] Argus Media. Battery Materials. Accessed September 15 2023. https://www.argusmedia.com/en/metals/argus-battery-materials
[48] Argus Media. Argus Methodology and Reference Listing. Accessed September 15 2023. https://www.argusmedia.com/en/methodology/methodology-listing

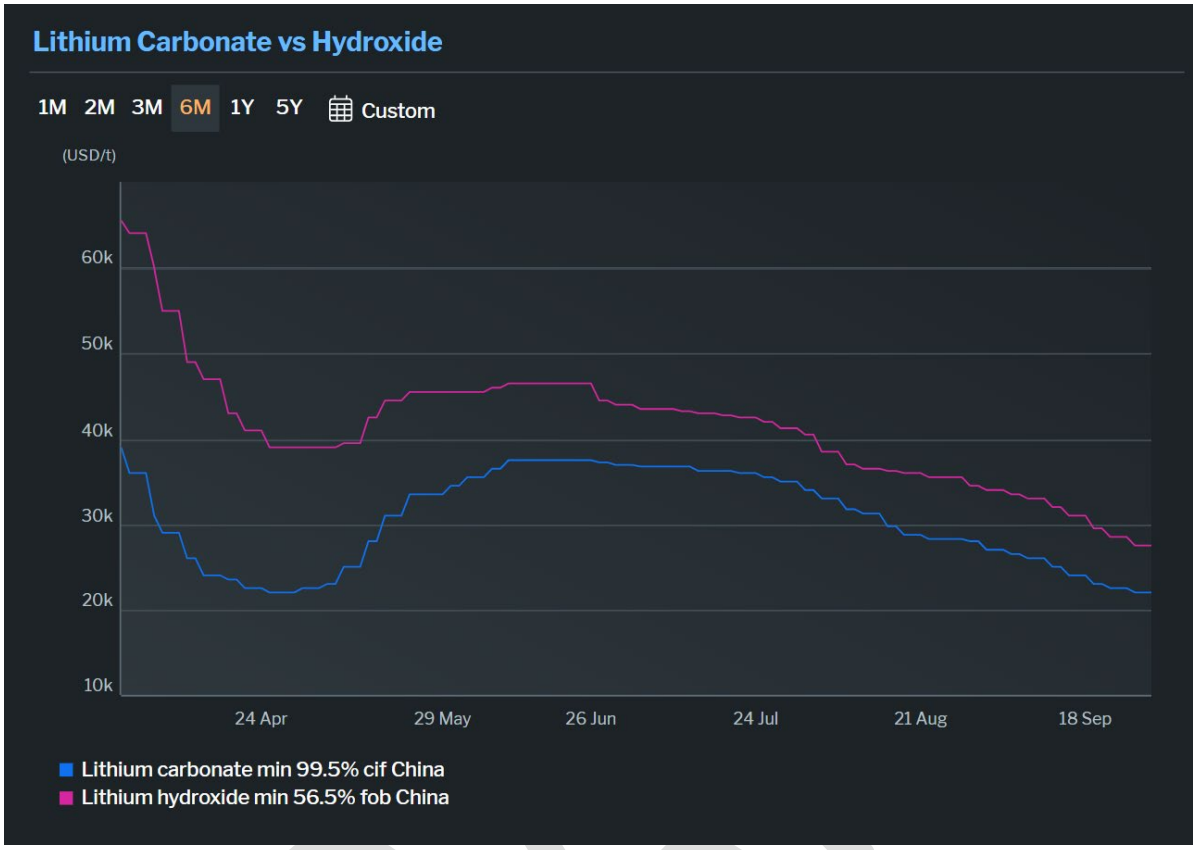
The main consumers of Argus lithium pricing assessments are producers and purchasers of raw lithium, as well as large-scale industrial buyers, especially automakers. Globally, businesses and governments use their data as benchmarks in the financial markets and to index physical trade.

Table 11. Argus Media lithium prices[49]

Product	Incoterm	Unit	Location	Frequency
Carbonate 99.5% incl. VAT	EXW	CNY/tonne	China	daily
Carbonate 99.5% ex-works China (ex-VAT)	EXW	USD/kg	China	daily
Carbonate 99.5%	CIF	USD/kg	China	twice weekly
Carbonate 99.5%	CIF duty unpaid	USD/tonne	Japan/ Korea	weekly
Hydroxide 56.5% inc VAT	EXW	CNY/tonne	China	daily
Hydroxide 56.5% ex-works China (ex- VAT)	EXW	USD/kg	China	daily
Hydroxide 56.5%	FOB duty paid	USD/kg	China	twice weekly
Hydroxide 56.5%	CIF duty unpaid	USD/tonne	Japan/ Korea	weekly
Concentrate (spodumene) 6% Li2O CIF China	CIF duty unpaid	USD/tonne	China	weekly
Concentrate (spodumene) 6% Li_2O FOB Australia*	FOB duty unpaid	USD/tonne	Australia	weekly

[49] Argus Media. Battery Materials. Accessed September 15 2023. https://www.argusmedia.com/en/metals/argus-battery-materials

Figure 10. Argus Media lithium prices



Source: Argus Media, personal communication.

Comparability Adjustments

Characteristics of the Product

Lithium Chemicals

As discussed in the section on commercial agreements, the most important determinant of the price of lithium carbonate or lithium hydroxide monohydrate, which are both used to produce battery cathodes, is their specifications. Buyers buy a specific product (lithium carbonate or lithium hydroxide) of a given grade (battery or technical/industrial) with given specifications. It is critical that producers have a qualified quality assurance system for the lithium chemicals to be recognized as battery grade in the market and priced accordingly. Otherwise, the product may have to be sold as a technical/industrial grade at a lower price, even if it is technically battery grade.

If the product does not meet specifications as stipulated in the contract, the buyers can reject it. If the product does meet the specifications, then the exact percentage of valuable material (lithium) or contaminants of a shipment does not affect the price. For example, if a contract provides for a lithium carbonate of a minimum 99.2% purity and the final product is 99.3%, the buyer does not receive a price premium for the higher purity. Or if a contract provides for a maximum amount of sodium, a contaminant, of 0.065%, the

price is not affected if the final level of sodium is below this amount—it is binary, i.e., it is the product within the specifications, as stipulated in the contract or not.

Lithium Mineral Concentrates

As discussed in the section on commercial agreements, the most important determinant of the price of lithium mineral concentrates is the content of lithium in the form of lithium oxide. The practice at the time of writing for spodumene concentrates is to contract for a standard product of 6% Li_2O, whose prices are transparent and published by price-reporting agencies, as documented in the earlier section. The price is then adjusted proportionally to the effective Li_2O content, as long as it is above a minimum amount, e.g., 2.5%. For example, if the lithium oxide content in a specific shipment of spodumene concentrate is 5.2%, then the price will be discounted accordingly (generally in a linear manner) from the standard product of 6% Li_2O.

As for lithium chemicals, if the product does not meet specifications, the buyers can reject it. However, the specifications are less strict for concentrates than for chemicals, as contaminants will be removed when concentrates are refined into either lithium carbonate or lithium hydroxide. Impurities in the concentrate do not generate discounts, as long as they meet specifications and there were no valuable, payable by-products at the time of writing.

Economic Circumstances

As outlined earlier, demand for clean energy sources, in the context of the energy transition and the increased demand for electric vehicles, directly impacts the lithium market. These economic factors led to the creation of lithium carbonate and lithium hydroxide price assessments. From a transfer-pricing perspective, this allows tax authorities to account for the temporal factors arising from global supply and demand by referencing price assessments that correspond to the period in which related-party sales contracts are entered into and/or when the specific transactions occurred (i.e. the date of when the good was sold if referencing an index assessment). This is particularly important, given that the current volatility of the lithium market and the relevant period in which the transaction occurred will have a significant bearing on the price.

In short, by referencing a lithium price assessment from a reputable price-reporting agency, one is able to account for global supply and demand factors, as well as economically significant aspects of the product—i.e., its grade, purity, and specifications.

Factors around the general structure of the production entities might have a material bearing on the lithium prices. For several years, most lithium was produced by an oligopoly of producers: Albermale, Sociedad Quimica y Minera de Chile (SQM), and Livent Corporation. Other producers have been added to this list, including China's Tianqi Lithium and Allkem based in Australia. Recently, both Livent and Allkem have announced their plan to merge to create a company that they forecast will have the world's third-

largest production capacity by 2027.[50] This will mean the existence of a few dominant players in the lithium industry that could be able to influence the market price of lithium.

The general structure of the consumption entities should also considered. At the time of writing, most large economies involved in the battery value chain had one to three major companies, with less than a dozen significant cathode producers globally. This type of market structure, combined with the strategic nature of the battery supply chain and the intervention of governments to secure supplies, could have an impact on prices in the future.

The production history, the general reliability of a lithium producer, and the size of the production mine itself may have an influence on price. As a general rule, a track record of stable production (including the stable quality of lithium) and larger mines can attract a premium on price. Smaller or newly developed mines may offer discounts to attract buyers. This would be expected to decrease over time as a mine establishes its supplier credentials. For instance, it is common for new lithium producers to sell their lithium carbonate or hydroxide production as technical grade during the first few years of production while they refine their processes and learn to comply with battery-grade specifications. As a result, their earlier production is sold at a discount compared to the later, battery-grade production.

Contractual Terms

Outside of the factors discussed earlier in this framework, the other economically significant adjustment relevant to the sale and purchase of lithium is the assignment of transportation responsibilities. The quantum of this adjustment is dependent on the product, volume, packing (i.e., bulk vs big-bags) and the proximity of the mine or port to the chemical plant.

The other consideration is if the related-party trade is delivered into another port on a CIF basis. As mentioned, the only markets large enough for price-reporting agencies to produce reliable market assessments are in East Asia: China, Japan, and Korea. These price assessments use either CIF incoterms for international sales or Ex-Works for Chinese domestic sales. When using these assessments in the price-discovery process, tax administrations should take into account the cost of transportation from their country's borders (i.e., FOB) to the place of delivery used in the price assessments (i.e., CIF).

[50] Livent Corp. - Allkem and Livent to Create a Leading Global Integrated Lithium Chemicals Producer

Appendix 1. Sources of Information for Lithium[51]

Provider	Use	Reference
Fastmarkets	Lithium pricing information	Lithium market news, analysis and price data - Fastmarkets
S&P Platts	Lithium pricing information	Lithium Carbonate Commodity Price Assessment | S&P Global Commodity Insights (spglobal.com)
SMM	Lithium pricing information	Lithium price assessments
Asian Metals	Lithium pricing information	Lithium prices, news and research - Asian Metal
BMI	Lithium pricing information	Lithium Price Assessments | Benchmark Mineral Intelligence (benchmarkminerals.com)
Argus Media	Lithium pricing information	Lithium prices
Platform for collaboration on Tax (IMF, OECD, UN & WBG)	Additional information on commodity pricing	Addressing Difficulties in Accessing Comparables Data for Transfer Pricing Analyses (oecd.org)
USGS	Lithium production and reserves information	Lithium (usgs.gov)

[51] Websites accessed in July 2023.

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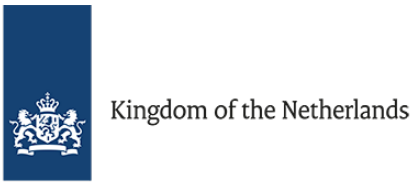

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